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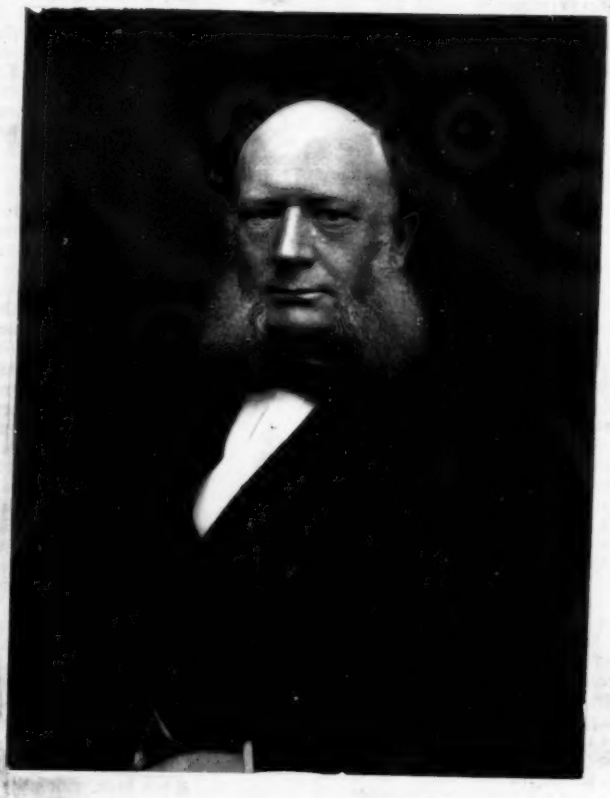


FROM A PHOTOGRAPH BY MR. E. J. MAYALL.

CHARLES WILLIAM SIEMENS.

DR. CHARLES WILLIAM SIEMENS, F.R.S., the celebrated engineer, who has gained a world-wide reputation through his researches on heat and electricity, his economical application of fuel, his metallurgical processes, and his scientific investigations, was born at Lenthe in Hanover, on the 4th of April, 1823. He received his education at the Gymnasium of Lubeck, the Art School of Madgeburg, and the University of Göttingen. Here he had the advantage of sitting under Wöhler and Himly, and laid the foundation of that knowledge in mechanics, chemistry, and physics, which he has ever since so well applied to useful results.

In 1842 he entered as a pupil the Engine Works of Count Stolberg, and there became acquainted

with tools and their uses, and with methods of work, thus obtaining that practical knowledge which helps to make the engineer.

In 1843 he visited England for the purpose of introducing a method of gilding and silvering by galvanic deposit, principally the invention of his elder brother, Werner Siemens. He returned immediately to Germany, and in the same year, the brothers invented a Differential Governor for Steam Engines. In 1844, C. William Siemens again came to England to patent this invention, and has ever since remained in this country, of which he became a naturalised subject in 1859.

In the same year (1844) was brought out the process of "Anastatic Printing," which invention was due to the two brothers, and was described by Professor Faraday in a lecture before the Royal Institution in 1845.

About this time Mr. Siemens was variously engaged: he was at times occupied upon railway works, upon improvements at Hoyle's Calico Printing Works, and upon several other inventions. Between the years 1844-47 he was occupied *inter alia* with the Chronometric Governor, the regulating action of which results from a differential movement between the engine and a chronometer. Several of these governors are in use at the Royal Observatory, Greenwich, for controlling the motion of transit and recording instruments.

In 1846 was introduced the double cylinder air-pump, in which the two cylinders are so combined that the compressing side of the first or larger cylinder communicates with the suction side of the second and smaller cylinder, whereby the limit of exhaustion is very much extended.

It was in 1847 that Mr. Siemens turned his attention to the then new study of the dynamical theory of heat, and also to the use of a regenerator for recovering that portion of the heat which presents itself at the exhaust port of a caloric engine.

The same year he constructed in the factory of Mr. John Hick, of Bolton, a regenerative engine using superheated steam, the principle attempted to be realised being to recover the latent heat of the steam by restoring to the same for each stroke only such an amount of heat as was expended in the production of mechanical effect. The fuel of the engine was consumed also by air previously heated to a considerable point by means of a regenerator or heat exchanger.

The first engine constructed upon this principle was of four horse-power. An engine of twenty horse-power was placed in the Paris Universal Exhibition of 1857, but not realising altogether the expectations of its designer, another of six horse-power was substituted, made by M. Farcot, of Paris, and was found to work with considerable economy. The use of superheated steam was attended with difficulty, however, and the invention has not been very extensively introduced.

In 1851 Mr. Siemens introduced his water-meter, which, both in its original and in a modified form, has been very extensively used both in this country and on the continent, the number in use being nearly 30,000. They act equally well under all varieties of pressure, and with constant or intermittent supply; they have been tested to register the flow to within 2½ per cent. of the measured quantity, and are manufactured in this country by Messrs. Guest and Chrimes at Rotherham, and in Berlin by Messrs. Siemens and Halske.

Between the years 1856 and 1861, Mr. Siemens, in conjunction with his brother Frederick, worked out the Regenerative Gas Furnace, an invention with which his name will ever be remembered. This furnace is too well known to require a detailed description, and we shall here only explain its main features. There is first the gas producer, a brick chamber with three openings, one above for the admission of fuel, which is closed after a charge is thrown in, a second below for the admission of a regulated quantity of air, and a third above for the exit of the gas, which consists of carbonic oxide, mixed with hydro-carbons, and diluted with air. The gas after rising perpendicularly to some height from the producer, traverses an overhead tube, and then descends a downtake to the foot of the regenerators. By this arrangement there is a continual flow of gas towards the furnace, the downward portion of the current to the furnace being always heavier than the upward from the producer. The regenerators are four chambers containing fire-bricks, so arranged as to allow a free passage of air or gas through them; these fire-bricks will be heated if hot air or gas pass through, and will heat cool air or gas. The regenerators are divided into pairs of two, one regenerator of each pair being connected by means of a suitable valve with the atmosphere, and the other with the producer. The furnace is placed above the regenerators, and there are two ports entering it, the one from the gas, the other from the air regenerator, and two leaving it to the other gas and air regenerator. When in action, and the furnace is at a certain high temperature, air enters the air regenerator from the atmosphere, and gas the gas regenerator from the producer; these are heated as they traverse the brickwork, and finally combine in the furnace, adding the heat of the brickwork through which they have passed to that of chemical combination or combustion: the heat melts or heats the work, and then the product of combustion passes down the exit regenerators which it heats to a high temperature; after a certain time, generally half an hour, the direction of the current is reversed by reversing valves. Each pair of regenerators is thus alternately employed to heat the entering air and gas and cool the products of combustion, which finally leave the chimney at a comparatively low temperature.

By this arrangement of furnace great economy is attained, great cleanliness in working, and purity of flame; but it has been principally valuable as, owing to the great heat obtainable, it has enabled metallurgical processes to be employed, which cannot be attempted in ordinary furnaces. The temperature is limited theoretically by the point of dissociation, and practically by the resistance to fusion offered by the refractory materials used in its construction.

This is hardly the journal in which to refer at length to metallurgical processes, but a memoir of Dr. Siemens would certainly be most incomplete if we did not refer shortly to his process of producing steel by direct fusion of the ores and other raw material.

Since 1867 Dr. Siemens has manufactured steel on the open hearth of his regenerative gas furnace.

Reaumur, in 1722, made steel by the fusion of malleable iron with cast iron in a clay crucible, and, acting upon this hint, Dr. Siemens persevered in his experiments, and thousands of tons of steel are now made of nearly the same mixture upon the open hearth of the furnace that has just been described. But it has taken years of hard labour, close attention to important details and circumstances, great powers of resource, and a commanding determination to overcome opposition, to say nothing of the expenditure of much capital before this result has been attained. Dr. Siemens made many attempts in England, and studied the question with his friend, the late Mons. L. Lechatelier, Inspecteur Général des Mines. Meanwhile Messrs. Emile and Pierre Martin, who had received licenses from Dr. Siemens, succeeded in producing cast steel by melting together pig iron, cast iron, and spiegeleisen. This kind of open-hearth steel making is now known as the Siemens-Martin process, and may be described as follows :—First, a bath of melted pig iron is formed on the bed of the furnace, and iron or steel scrap is added, till, by repeated trials, a sample taken out and cooled in water is found to be of the right temper. Then ferro-manganese or spiegeleisen is added, and when this is melted the charge is drawn off. The consumption of coal is from 13 to 14 cwt. for every ton of steel produced. In a modification of the process introduced into extensive practice by Dr. Siemens, pig iron is melted on the furnace bed, and iron ore then added in the proportions of from 20 to 24 cwt. of ore to five tons of pig iron.

Dr. Siemens is now erecting furnaces which will hold a charge of 10 tons, and will produce 20 to 30 tons of steel in 24 hours. This steel is much employed for all kinds of machinery purposes where high quality and uniformity are essential, and also in the construction of steel ships and boilers, which are gradually supplanting iron.

While introducing the Open Hearth Process as a considerable advance in the mode of production of steel, Dr. Siemens has been working to accomplish the further result of making steel and iron direct from the ore, and with this end in view, he constructed, in 1866, his sample steel works at Birmingham, and, in 1867, he sent several samples of steel produced in this manner to the Universal Exhibition at Paris. The first experimental attempts led to the construction of the Rotatory Furnace, by which that end is effected; and although it is as yet only employed upon a limited scale, its use is gradually extending. The latest results obtained with this furnace, were communicated at the autumn meeting of the Iron and Steel Institute, at Newcastle, last year.

It was in 1868 that he originated the Landore Siemens-Steel Works, which manufacture upwards of 1,000 tons of cast steel per week, and are, therefore, among the most extensive works of the kind in this country.

The Steel Company of Scotland, Vickers and Co. of Sheffield, the London and North Western Railway Works at Crewe, and other leading works, both in this country and abroad, are licensed by Dr. Siemens for the production of steel according to the processes we have described; the works in this country are capable of producing 250,000 tons, whilst the actual production last year in finished articles was over 140,000 tons.

Ever since the year 1848, Dr. Siemens has been interested in telegraph engineering. In 1858 he established, with his brother, Dr. Werner Siemens, and Mr. Halske, of Berlin, and with his brother, Mr. Carl Siemens, then of St. Petersburg and now of London, Siemens, Halske, and Co.'s Telegraph Works in London, which are now known as those of Messrs. Siemens Brothers. They have been considerably extended since their formation, and from them telegraph lines have been shipped to various quarters of the globe. The Indo-European telegraph line was constructed by Siemens Brothers in connection with their Berlin house, as also the North China Cable, the Platino-Brazileira Cable, and others. But the most important telegraphic enterprise that Dr. Siemens has been identified with, is that for which the celebrated steamship *Faraday* was built.

This vessel, constructed according to designs of which the conception was due to Dr. Siemens, was employed in 1874 in laying the Direct United States Cable, and succeeded in paying out nearly the entire length in perfect condition; but, as the stormy season had set in, it was deemed advisable to buoy the cable and to defer any further attempts to finish laying it until the summer of 1875. The *Faraday*, therefore, returned to England, and during the winter was refitted, and in June succeeded in completing the work. But a fault was discovered, and another return to England for a piece of cable of sufficient length to repair the damage was found necessary. Early in September the cable was put in complete working order, and on the 15th was opened to the public for the transmission of messages.

The *Faraday* is a peculiar vessel, having stem and stern alike. She was built by Messrs. Mitchell and Co., at Newcastle, and is 360 ft. long, with 52 ft. beam and 36 ft. depth of hold. She has a rudder at each end, and either of them can be rigidly fixed when required. Two screw propellers, driven by a pair of compound engines, furnish the motive power, and are so placed at a slight angle to one another, that the vessel can turn in her own length when the engines are worked in opposite directions. As the ship can steam backwards of forwards with the same facility, in case a fault is discovered in the cable in the bow compartment, it is not necessary to pass the cable astern before hauling it in, but merely to reverse the motion of the ship, having the stern rudder fixed and making the bow the stern, and a small engine hauls in the cable over the drum just employed to pay it out. The *Faraday* was fitted out with everything necessary for laying the cable, as well as for grappling and recovering lost cable, and a steam launch carried on deck to be used in landing shore ends, was found to be of much service.

The Direct United States Cable, in the successful completion of which Mr. Carl Siemens, Mr. L. Loeffler, and several of the leading employés of the firm of Siemens Brothers, so zealously co-operated, must be regarded as an important step in Telegraph Engineering.

In the scientific world the labours of Dr. Siemens have been appreciated. He is a member of many learned societies. He was elected a fellow of the Royal Society in 1862, and in the year 1869 and 1870 he served on its council. He has long been a

prominent member of the Institution of Civil Engineers, being a member of its council and of that of the British Association. He, at intervals, has been one of the managers and vice-president of the Royal Institution, and has been president of the Institution of Mechanical Engineers. He was also the first president of the Society of Telegraph Engineers, and has been again this year unanimously elected to this honourable position. He was elected president of the Mechanical Section for the conferences held under the auspices of the Loan Exhibition, and gave a valuable inaugural address on "Measures." The Iron and Steel Institute claim him as one of their most honoured members, and last year he was elected president of the Institute, a position which he still holds.

He was elected president of the International Patent Congress at Vienna, and shortly after an honorary member of the Austrian Society of Engineers and Architects.

In the February of last year, after his recent visit to America, he was elected an honorary member of the American Philosophical Society, and in October of the same year was elected with Mr. Bessemer the first honorary members of the very ancient Society the Gewerbe-Verein of Berlin.

In 1871 he was brought into the Athenæum Club by the Managing Committee, and has since then served as a member of the same committee. He is also a member of the Philosophical and Royal Society Clubs.

Dr. Siemens has presented many scientific papers to these societies. His first paper was presented to the Institution of Civil Engineers on the 17th of May, 1853, and was entitled, "On the Conversion of Heat into Mechanical Effect." It was the first paper published in this country which considered the subject of heat engines from the point of view of the mechanical theory of heat, and, although a quarter of a century has nearly elapsed since it was read, it may be to-day taken as a guide to the subjects to which it has reference. Between this period and 1860 he described his governor, steam engine, and water-meters, in papers to the Institution of Mechanical Engineers.

In 1862 he presented to the Institution of Civil Engineers a very elaborate paper "On the Electrical Tests employed during the construction of the Malta and Alexandria Cable, and on insulating and protecting submarine cables."

In 1863 he prepared a paper on "Observations on the Electrical Resistance and Electrification of some Insulating Materials, under pressures up to 300 atmospheres," which was published in the British Association Report for that year. The two main points brought out were that the inductive capacity of gutta-percha is not affected by increased pressure and that of india-rubber is diminished.

In 1866 Dr. Siemens presented to the Royal Society a scientific paper on "Uniform Rotation," which is printed in the Philosophical Transactions.

On the 14th February, 1867, was read his paper "On the conversion of dynamical into electrical force without the aid of permanent magnetism," which is peculiarly interesting as being the first scientific enunciation in this country of the dynamo-electric principle upon which the most powerful light producing machines depend.

Another scientific paper presented by him to the same Society in 1871, "On Electrical Resistance," was made the Bakerian Lecture for that year. It treats of a method of measuring variation of temperature by variation of electrical resistance; and the new instruments described in this paper, the electrical resistance thermometer and pyrometer, in connection with the differential voltameter, are already being appreciated as valuable auxiliaries in thermometry, and in metallurgical research. These instruments allow of the measurement of temperature without any break, from the lowest attainable degree of cold to a temperature approaching that of the fusion of platinum.

Between this period and 1876 he read various papers, principally on metallurgical questions, before the Iron and Steel Institute, the Chemical Society, and the British Association.

In February, 1876, he read a paper "On the Action of Light on Selenium," before the Royal Institution, and presented his paper "On determining the depth of the Sea without the use of the Sounding Line, and on an Attraction Meter," to the Royal Society, which has since been published in the Philosophical Transactions of that body.

Many other papers presented by Dr. Siemens to scientific bodies (notably that on puddling iron, read before the British Association in 1868, showing incontestably that the carbon and silicon can be made to leave the pig metal by the action of the fluid oxide of iron present, alone), all treating of subjects of varied scientific and practical value, might be here considered, but we must be content to refer our readers for particulars to the Transactions of these bodies.

In a short memoir of this kind, and one treating, moreover, of a busy worker, whose every day and hour is employed, although much has been said, a great deal remains unsaid, and we shall complete this with a list of the awards Dr. Siemens has obtained.

The Society of Arts presented him with its gold medal for his regenerative condenser in the year 1850, and the Institution of Civil Engineers, in the Session 1852-53, with its Telford medal for the paper already referred to.

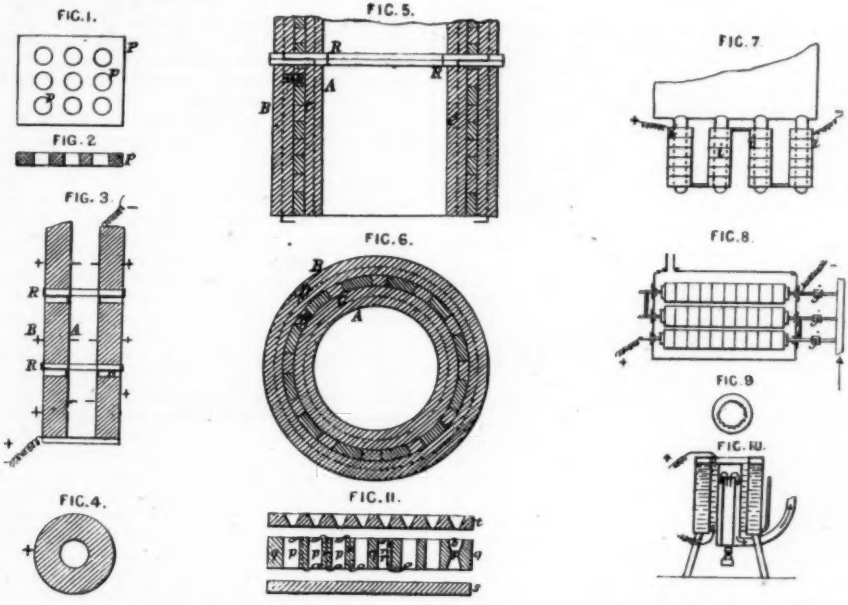
In 1851 and 1862, Dr. Siemens received prize medals of the London Exhibition, and in 1867 was awarded a Grand Prix at the Universal Exhibition of Paris for his regenerative gas furnace and steel process. In 1869 the degree of Doctor of Civil Law, *Honoris causâ*, was conferred upon him by the University of Oxford, and in 1874 he received the Royal Albert medal for his researches on heat, and for his metallurgical processes. In 1875 he received the Bessemer medal of the Iron and Steel Institute "in recognition of the valuable services he has rendered to the iron and steel trades by his important inventions and investigations."

Dr. Siemens was appointed first a Commander and subsequently a Dignatario of the Brazilian Order of the Rose. It is not often that life-long exertions like these are recognised by governments, and hence among the few recognitions of this description, this from the Emperor of Brazil must have been of a very pleasing character as coming, moreover, from a Potentate so qualified to judge of scientific and technical merit.

CLAMOND'S THERMO-PILE.

IT is well known that Clamond's Patent Thermo-Pile, in its earlier form, failed to bear up under the ordeal of continued use. It has not, however, on that account been abandoned altogether. Further improvements have been made, and it is hoped that its failings will thereby be overcome, while its merits are brought more conspicuously out. These improvements are embodied in an English patent, No. 1583, of 1877. They relate to the casting and forming of the thermo-electric elements themselves, and to the manner of grouping them together into a pile or generator.

The current obtainable from a thermo-electric element or pair, depends, of course, on the two



metals employed, the difference of temperature maintained between the ends of the thermo-electric bar, that is to say between the junction of the metals and the free ends, and the resistance of the bar. With a given pair of metals the strength of current available depends solely on the difference of temperature kept up and the resistance of the bar; the greater the difference of temperature and the less the resistance of the bar, the greater is the current strength obtained. But with the stout bars employed in thermo-piles, electric resistance may be neglected. A certain proportion or relation must always exist between the section and the length of a bar, in order that the two extremities may be easily maintained at very great differences of temperature. The result is that when intense currents have been required, it has been the custom hitherto in constructing thermo-piles, to increase the length and thickness of the thermo-electric bars conjointly; but this plan entails both heavy and costly apparatus, and necessitates the employment of very large masses of metals or alloys. The first improvement in the new patent is designed to remedy this inconvenience by the intervention of a partition or plate of some material, which is a bad conductor of heat and electricity, such as amianthus, terra-cotta, or mica, between the two ends of the thermo-electric bar, without breaking the metallic continuity of the latter, and allowing sufficient sectional area of metal to connect both ends of the bar. By means of this heat screen of non-conducting material, partially dividing the bar into two parts, the heat from the hot end is in great part prevented from radiating and being conducted to the cold end.

Figure 1 represents a plan, and figure 2 a section of this non-conducting diaphragm such as would, be employed for a single square thermo-electric bar, *p* and *p* being holes through which the bar is cast, so as to make the alloy continuous. If such a plate be placed in a mould for casting the bar, the metal on each side of it will be united by little cylinders of metal through the holes. Bars thus made are like partitioned metal plates, a form which permits of their sectional area being increased without increasing their length. Great differences of temperature with a very small distance between the pole plate, and consequently a much greater production of electricity with less metal employed and less heat expended, are the results. This diaphragm, as the patent points out, fulfils, in some degree, the function of a porous vase in a voltaic cell, which, while putting two liquids

in contact, in such a manner as to permit the passage of electricity, prevents them mixing too quickly.

Figure 11 represents another mode of making elements suitable for the construction of small thermo-piles for domestic purposes. The figure is a section of a group of elements, *q q* being a perforated plate or flat cylinder of plaster of Paris, earthenware, or other non-conductor of heat and electricity. *p p* are perforations into which a thermo-electric alloy (say two parts zinc and one part antimony) is cast, *r r* are wires of German silver, or other thermo-electric metal, one end being cast into the alloy at the bottom of one pole, the other end passing through a hole in the material of the diaphragm to the top of the next pole, where it is likewise cast into the alloy. If preferred, the wire may be coated with asbestos paper, or other insulating material, as shown at *r r*, and cast into the alloy itself. In either case the end of the wire is curved into the form of a ring, so as to give ample conducting surface to the metal to ensure good contact. In this way the thermo-electric junctions are formed and connected to each other "in series." The perforations in the diaphragm may with advantage be formed like a double cone, as shown at *b p*, so as to retain the alloy firmly in its place. The plate *s*, of earthenware or metal, is the bottom of the mould or hearth on which the diaphragm is laid when the casting is made; and *t* is an upper plate pierced with holes, which are arranged opposite the holes in the perforated plate, so that the separate bores may all be filled at once, by one ladleful of the melted alloy. The diaphragm with its accompanying plates *t* and *s*, may be curved in the form of a segment of a circle, so that two or more segments placed together may form a cylindrical battery. Small piles so formed can be heated over an ordinary gas flame or lamp chimney.

This leads us to the second new improvement: the manner of building up the thermo-electric elements into a pile or battery. The general form selected for the pile is that of a large hollow upright tube, with the heated junctions set round the internal wall, and the cool junctions set round the external wall. Such a tubular pile can be built up of cylindrical elements, connected in series, the positive and negative poles of the pile appearing at the top and bottom of the pile respectively, or *vice versâ*. Figures 3 and 4 exhibit this arrangement of the elements. Each cylindrical element is separated from that above and below it by a non-conducting plate of mica or asbestos R; all the negative poles are shown at the interior of the tube, and all the positive poles at the exterior; while the two terminal poles of electrodes of the entire battery are shewn by wire spirals at the top and bottom. Figures 5 and 6 represent this mode of arranging the pairs in greater detail, 5 being a vertical, and 6 a horizontal section through the pile; A and B are interior and exterior protecting tubes or envelopes covering the pole tubes C D, which form the junctions with the thermo-electric alloy. To obtain good contact between the alloy and the pole tubes, the latter are made of riddled or pierced metal, or of metallic cloth, so that the molten alloy can permeate them; D is the cool or exterior pole or junction, and C the interior; while E is the non-conducting diaphragm, pierced with holes, and embedded in the thermo-electric alloy. Each single element is, therefore, in the form of a flat cylinder, compounded of the inner and outer pole cylinders C D, with their protecting cylinders A B, and the intermediate cylindrical partition of non-conducting material E; the whole being united by the thermo-electric alloy into one solid ring. Out of these single cylindrical elements the tubular pile is built up after the manner of figure 3, where three elements are shown, one above another, forming a tube. If the interior of such a tube of elements, be heated while the exterior is kept cool, the inner tube C will become a negative pole, while the outer tube D will be a positive pole in each of the elements. To connect them up in series for "intensity" currents, it is therefore necessary to join the inner pole cylinder C of one ring element, to the outer pole cylinder D of the next. In this way all the ring elements are connected together and the poles of the battery or generator appear at the ends of the tube as shown. To separate the different elements from each other in the pile layers or washers R R, of caoutchouc, asbestos, or other insulating and infusible material, such as is used for steam tubes, are employed.

The necessary source of heat for producing the thermo-electric currents may be obtained from a charcoal fire, from the waste heat of a furnace, or from gas. Where gas is employed as the source of heat, the apparatus is arranged as shown in fig. 10, which consists of a thermo-electric tube having its interior heated by a flame or brazier. The heating surface is increased by being serrated, and is protected against the immediate contact of the flame by a return flue, which causes the products of combustion to re-traverse the interior before finally passing off by the chimney. The tube is also surrounded on the outside by an envelope of cold water to act as a refrigerator to the outer poles. Two other sources of heat are utilised by the inventor, namely, the steam boiler tubes at a high temperature, and waste steam. Fig. 7 shows the first of these; the tubular piles, *i i*, being made to enclose steam boiler tubes, as in the Field boiler. Fig. 8 shows the second plan, in which tubes receiving steam to be condensed are enveloped by the thermo-electric tubes, which are isolated from them by rings of caoutchouc or other material.

The manufacture of Clamond's new pile in this country, is in the hands of Messrs. Latimer Clark, Muirhead & Co., Westminster.

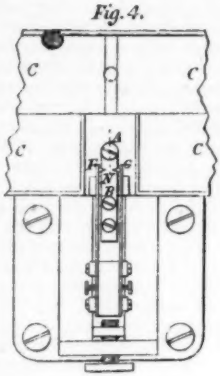
TOMMASI'S TELEGRAPH APPARATUS FOR WORKING LONG SUBMARINE CABLES.

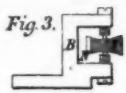
Transmitting Apparatus.

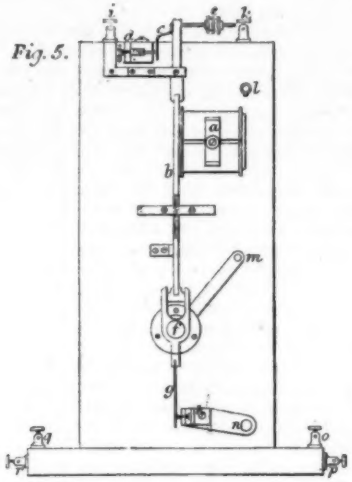
THIS is shown in elevation by fig. 1. B is a finger key, of which there are ten, arranged side by side in a row, so that they can be easily manipulated when signals have to be sent by their means. By pressing with the finger on the button or knob B, the spring C causes the ratchet wheel D to make $\frac{1}{8}$ of a revolution, which, by means of a toothed wheel E and pinion F, produces $\frac{1}{4}$ of a revolution of the washer G. This washer is of hardened india-rubber, and serves as nave to the four springs H set round it like spokes.

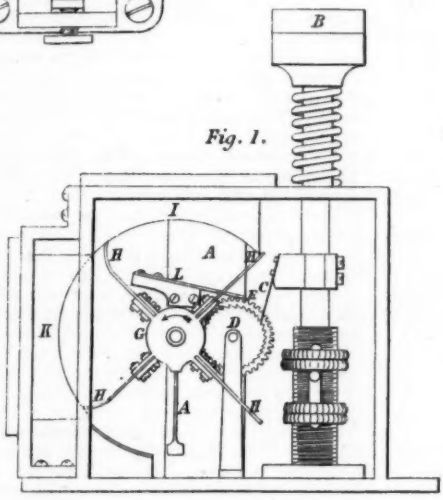
These springs, the ends of which are of platinum and which are perfectly insulated from each other, slide by the effect of the rotation of the washer G upon plates of platinum arranged for this purpose in the grooves of the pieces of hardened india-rubber I and K.

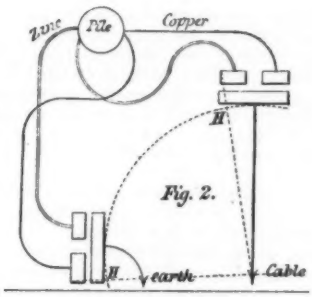
The result of these arrangements is that when one of the springs H places the zinc pole of the pile in communication with the earth, the other spring H places the copper pole of the same pile in connection with the cable or the aerial wire (accordingly as the communication is submarine, underground, or











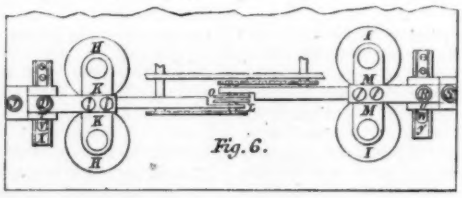


Fig. 2 shows the arrangement of these plates, which, for thorough comprehension of their working, are drawn in plan, whereas, in accordance with the position of the springs H, they should have been represented as seen in elevation.

by wires suspended from posts), and that on the contrary, when one of the springs H places the copper pole of the pile in communication with the earth, the other spring H places the zinc pole of the same pile in connection with the cable or

with the aerial wire. The result is a reversal of current at each contact established by the springs H between the short plates and the long plates fixed in the groove of the pieces I and K. Therefore, by pressing on the knob B, two successive waves of electric current are sent into the cable, both of equal duration, but always of a different designation; that is to say, if the first is negative the other is positive, and *vice versa*.

If instead of fixing one long and two short plates fixed in the grooved part of the pieces I and K, as shown in fig. 2, four or even six short and one long one are fixed therein, it is evident that by pressing on the knob B four or six successive waves of electric current of equal duration will be sent into the cable or aerial wire, and that it depends solely upon the manner in which the short plates are placed in connection with the poles of the pile whether these waves are always of a different designation; that is to say, whether a positive wave is always followed by a negative one, and *vice versa*.

By varying the grouping of these waves in the mechanism of each of the ten keys, ten different combinations may be obtained without going beyond a maximum of six waves per group, the three reversals of current inclusive.

When desired, only two knobs or studs may be used, and consequently only two combinations, one of which will represent conventionally a dash and the other a dot; the ordinary "Morse" code would be employed.

The signs produced upon the receiving apparatus (as will be seen) by nine of these combinations, represent conventionally each of the nine numbers or numerals, and the signs produced by the tenth combination represent the zero or nought.

The result of all this is that the operator or sender of the telegram or dispatch (this telegraphic dispatch being always written in figures as will be explained) has no other operation to perform than to press successively the ten knobs marked with the numbers composing the figures which he is to transmit, according to the indications of the dispatch.

If the mode of transmission adopted is the "Morse" code, in which case two knobs only would be employed, the sender has only to press with his finger on the knobs, which produce, as will be seen, a red dot and a blue dot (which conventionally represents a dot) or upon the other which produces a blue dot and a red dot (which conventionally represents a dash) accordingly as he is to send one or other of these signs.

It need scarcely be observed that by means of its spiral spring each knob or stud returns to its place directly the pressure of the finger of the operator is removed, and that this movement has no effect upon the washer G, owing to the spring L, which compels the wheel E to turn only in one direction, and also to the ratchet wheel D, which permits the spring C to rise again by sliding over its teeth, and consequently without setting it in motion.

To apply this system to aerial wires, as in these conductors, the unequal duration of the waves of electric current produce no inconvenience; an ordinary manipulator may be used, arranged so as to reverse the current automatically after each signal, the receiving apparatus being so arranged that the reverse current will produce no sign.

Receiving Apparatus.

This is composed of—

1st. A main relay, shown by figs. 3 and 4.

2nd. Two accessary relays to which are given the name of interrupting relays, shown by fig. 5.

3rd. A "Morse" receiver shown by fig. 6.

4th. An ordinary interruptor and electric striking work not shown upon the drawing.

The small bar A, fig. 3, is of steel, tempered and magnetised; its lower pivot which terminates in a cone rests by its point only on the point of an inverted cone hollowed out of a hard stone, or in a small block of well tempered steel; the upper pivot, which likewise ends in a cone, also rests by its point only upon the point of a cone hollowed out of a small block of well tempered steel. The hard stone or the block of steel is set in the lower screw and the block of steel in the upper screw, which are placed at the end of the fork B; the base of the cones hollowed out of the hard stone and the small block of steel having a diameter equal to twice the diameter of the pivots, and a depth equal to that of the cones of these latter, the surfaces are everywhere perfectly smooth and polished, and the arching or curving of the piece is absolutely perfect; the result is that the friction of the pivots of the small bar A are almost null, and that nevertheless these pivots must forcibly always remain in the centre of the hollow cones, and that consequently the position of the small bar A never leaves that vertical line notwithstanding the evolutions which it may have to perform.

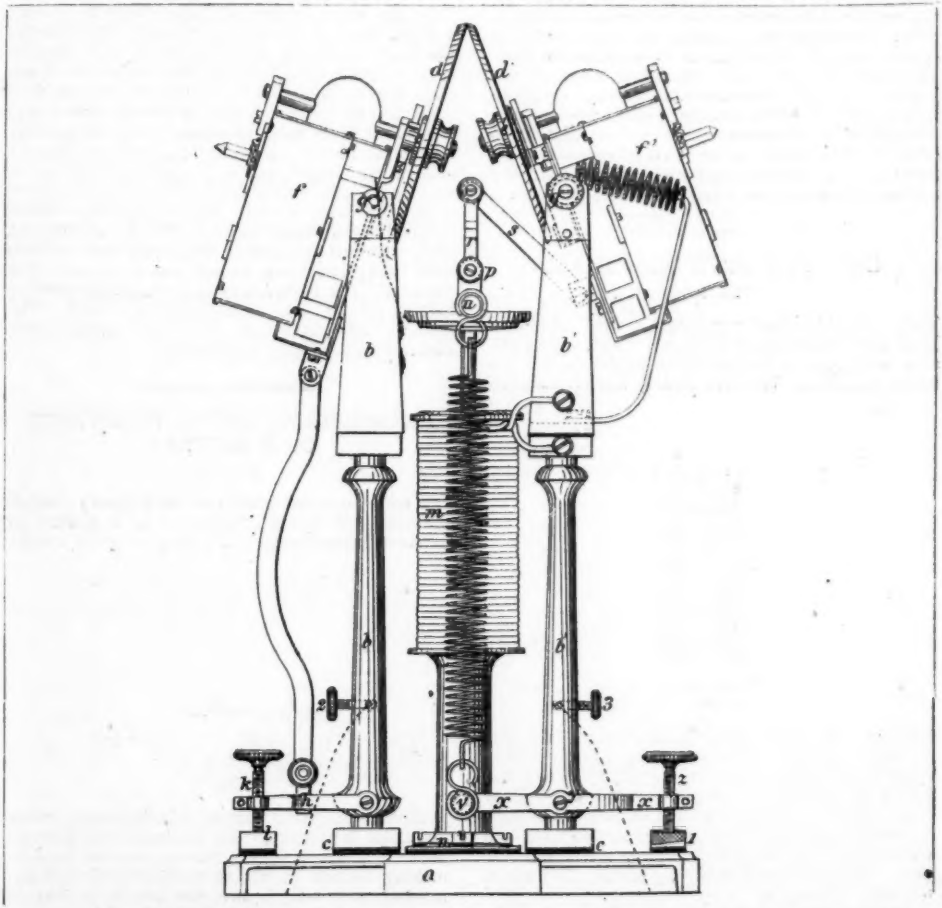
The centre of rotation of the small bar A is placed in the axis of the two poles of an electro-magnet formed by the double horse-shoe, fig. 4, around which is wound insulated copper wire, which forms the four reels C. The result is, that so long as no current passes through this wire the small bar A remains motionless, and parallel to the cheeks or flanges of the reel C either from the effect of the attraction which the two poles of the electro-magnet (which at this moment act simply as iron) exercise equally upon its two poles, or from the influence of the magnetised bar E, which compels the small bar A to keep the same direction as itself; but directly a current, however weak, circulates in the wire, the horse-shoe is immediately transformed into a magnet, and its two poles become the one positive, the other negative. The small bar A is then compelled to turn upon itself under a quintuple influence, namely—

1st. The quadruple influence which the poles of the electro-magnet exercise upon it, for its negative pole is attracted by the positive pole and repelled by the negative pole of the electro-magnet, whereas its positive pole is attracted by the negative pole and repelled by the positive pole of the aforesaid electro-magnet.

2nd. The influence which the passage of the current in the two reels, placed in front of the north pole of the small bar A, exercises upon this latter; the result is that the small bar A is so sensitive to the slightest passage of the current in the reels C that $\frac{1}{100}$ of the current of a single element "Minotto," after having traversed a resistance equal to that of a transatlantic cable, is more than sufficient to make it work. Now as the south pole (N) of the small bar A is always approaching the side of the positive pole of the electro-magnet, and as the operator or

telegraphist may at pleasure send the currents so as to transform into positive pole either the pole on the right or that to the left of the electro-magnet, the south pole of the small bar A may at the will of the operator travel either to the right or to the left, and consequently touch either the spring G, or that, F. The small bar A being in metallic contact with the fork B by the intermediary of the small block or small blocks of steel, the fork B being in connection with one of the poles of a local pile, the spring F with the electro-magnet *a* (see fig. 5), the spring G with the other electro-magnet of the other interrupting relay, which is not seen in fig. 5, and these two electro-magnets being in connection with the other pole of the same local pile, the result is, that when the south pole of the small bar A touches the spring F the armature *b* is attracted and the spring *c* touches the button or stud *d*, and when the south pole of the piece A touches the spring G the same manœuvre is produced upon the other interrupting relay. Now the knob or stud *d* being in connection with the terminal *i*, which is itself in connection with the electro-magnet H by the intermediary of a terminal (see figures 5 and 6), the spring *c* being in connection by means of the terminals *k* and *r* with one of the poles of a second local pile, and the other pole of this pile being in connection with the electro-magnet H, the result is, that at each contact between the spring *c* and the knob or stud *d* the armature K is attracted, and the spur wheel L prints a red dot upon the strip of paper.

(*To be continued.*)



THE REGNIER ELECTRIC LIGHT LAMP.

THIS ingenious form of lamp, of which we give an illustration, possesses very distinct points of novelty from those which have been previously designed. Abandoning the carbon points, M. Regnier employs two circular discs of carbon, inclined towards one another, so that the voltaic arc passes between their edges. By keeping the discs in slow but continuous rotation, fresh portions of the edges are presented

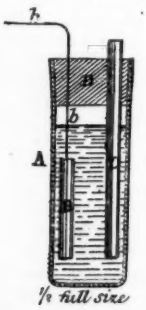
to the action of the current, and thereby the necessary equal space for the voltaic arc to traverse is preserved.

In the figure, *a* is the base of the apparatus, *b b' b' b'* are forked standards, *d d'* carbon discs having a continuous rotary motion imparted to them by the clockwork motors *f* and *f'*. At *g g'* are the trunnions on which both discs and motors oscillate; *i h* is a forked lever connected to the motor *f* by a long curved rod; *k* is a button screwed on the end of this lever, and ending in the cup *l*. By means of this screw the motor *f* can be caused to move backward or forward so as to adjust the carbons. *m* is a coil of wire surrounding a soft iron magnet (not shown).

By means of the rod *p*, crank *r*, and arm *s*, this magnet by pulling downward moves the motor *f* to the rear, and determines the separation of disc *d*. At *t t* are springs which tend to move the disc *d'* in contact with the disc *d*, and so to establish the light. These springs, attached at *u* and at *v*, act on the motor *f* through the crank *r* and arm *s*. *x y z* is a forked lever attached at one end to the springs and carrying at its other extremity a set screw, by means of which the springs can be more or less extended, and the lamp thereby regulated. 2 and 3 are the terminals to which the battery wires are attached.

CHLORIDE OF SILVER CELL.

THE annexed figure represents a small form of De la Rue's chloride of silver cell, which is remarkably well adapted for electrical testing, either on shore or at sea. We have already had occasion to



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mention the special qualities in favour of this cell for such a purpose—its very constant electro-motive force from time to time, and especially during the taking of insulation resistance tests, its freedom from variation in electro-motive force when shaken or otherwise disturbed, its small portable form and cleanliness, and its comparative economy in the end. We hear that it is already coming into use as a testing battery.

In the diagram, A is a glass vessel, closed at the top to keep out dirt by a stopper of cork or solid paraffin D, but preferably of cork, because it can be handled with more ease and fits the cell more tightly than paraffin, which is apt to work loose when fitted to glass.

The negative pole C consists of a cylindrical rod of chemically pure zinc supported by the cork stopper, which is perforated to receive it. The zinc rod has a hole in the top to allow the silver connecting wire or electrode which goes to the next element to be soldered in.

The positive pole consists of a cylinder of silver chloride B, having a silver wire or electrode *b* cast into it. This chloride rod is usually enclosed in a hollow cylindrical diaphragm of fine parchment paper.

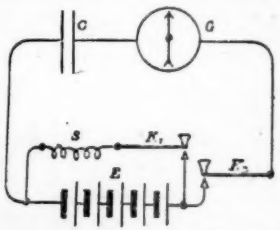
The solution for charging the cell is made by dissolving 23 grammes of pure sal-ammoniac or ammonium chloride in one litre of water.

The electromotive force of each element is about 1·10 volts, and the internal resistance is about 8 ohms. Both of these qualities are very constant.

In the action of the cell, pure silver is reduced and deposited on the floor of the cell. To prevent the short circuiting of the poles by this metallic deposit, it is best to keep the zinc rod about three-eighths of an inch raised above the floor of the cell. This pure silver deposit can be readily turned into chloride of silver again by means of a small quantity of chlorine, and it is then only necessary to melt the chloride so formed, and re-cast it into rods for use over again, otherwise the pure silver may be sold as it is. We have already pointed out in a recent number of the TELEGRAPHIC JOURNAL that twenty, fifty, or even a hundred of these cells can be fitted with solid paraffin into a small box easily carried in the hand, so as to form a convenient portable testing battery for the use of electricians abroad. For medical men employing the feeble current cure, this cell is also highly convenient.

MEASUREMENT OF THE RESISTANCE OF A BATTERY.

THE following modification of the ordinary method of testing the internal resistance of a battery by means of a condenser is said to give good results.



In the accompanying diagram, E is the battery, whose resistance is required, C is a condenser, G a galvanometer, S a shunt, and K_1 and K_2 are two keys for making contact. In making the test by the ordinary method, as is well known, the key K_1 is first depressed, and the deflection on the galvanometer due to the charging of the condenser by the whole battery current observed. The condenser is then discharged, and the battery shunted with S, and a second deflection observed on the galvanometer, namely, that due to the reduced battery current.

From these two deflections the resistance r of the battery is found by the formula,

$$r = \frac{D - D^1}{D^1} \times S,$$

where

r = resistance of battery in ohms,
S = resistance of shunt in ohms,
D = deflection obtained with battery unshunted,
D^1 = deflection obtained with battery shunted.

It is advantageous in making this test to observe D^1 as soon as possible after the shunt S has been applied to the battery, since its application changes the internal state of the battery by altering the conditions of working, especially if it be small. The best result would be obtained at the instant when the making contact with K_2 inserts the shunt. Instead of charging the condenser two separate times, however, it is only necessary to charge it once, namely, when taking the full deflection D. If while it is thus charged, the shunt S is inserted by depressing the key K_2, this has the effect of partially discharging the condenser, and causing a back throw on the galvanometer. This reverse deflection deducted from the full deflection D, should give a highly correct value for D^1, since it is due to the instantaneous application of S.

Reviews.

The Telegraph Pocket-book, Diary, and Telegraph Code for the year 1878. Edited by Lieut.-Col. FRANK BOLTON, Hon. Sec. Tel. Eng., and JAMES SIVEWRIGHT, M.A., Superintendent British Postal Telegraph Service. Letts, Son, & Co., London.

THIS handy little volume, which has lately been issued, is likely to prove very useful, containing as it does, a large amount of judiciously selected matter relating to both the scientific and commercial branches of telegraphy.

Commencing with a selection of formulæ which are likely to be useful to the practical electrician and telegraph engineer, and amongst which we notice a valuable estimate for the quantities of materials and cost of labour required in erecting an overground and underground line, there follow several pages of diagrams, showing the connections and methods of joining up the various telegraph instruments in use. These will prove very useful for inspectors who have charge of the various kinds of apparatus, and who, altho ugh gifted with good memories, may, at times, be at fault when making changes in some of the more complicated systems.

An epitome of electrical, magnetic, and telegraphic history, dating from B.C. 600, shows well the progress of the science.

The British Telegraph system naturally comes in for a fair share of notice, and several pages are devoted to useful matter, having reference chiefly to the regulations concerning the despatch and receipt of telegrams, the tariffs for the same, and for the renting of private wires, the distribution of time signals, etc.

We notice from the diary that in France there are four kinds of telegraph offices, viz., offices worked by the Telegraph Department, Municipal Offices, Semaphore Stations, and Lock and Weir Stations. The latter are for the purpose of working the boat service, and giving timely notice of the approach of floods.

Full particulars are given of the boards of management of the various submarine telegraph companies, together with the lengths of the various sections of cable owned by them; the tariffs are also clearly indicated.

A telegraph code, which completes the telegraphic matter, forms one of the most useful features of the book, and will be particularly useful to those who have to transact much business by the aid of the telegraph. The code is so arranged that many sentences in common use in the English language can be expressed by a single word, and it has been prepared for one thousand such words and sentences, many of which will, of themselves, form complete messages of a frequently recurring description.

Following a description of signalling with flashing signals, comes a list of telegraph engineers and contractors, and then seven pages of Messrs. Letts' publications, from "The Family Washing Book" to "The Angler's Register." The appropriateness of the introduction of this catalogue is not, at first, very apparent, but upon reflection, it seems to dawn upon us. No doubt Messrs. Letts mean to suggest that the Atlantic, or, indeed, any other sea, may be regarded as if it were a washing-tub into which our submarine cables have been thrown, and that, as a check upon the carelessness and dishonesty of old Tethys Oceanus' "Missus," it is prudent to keep an inventory of what we have thus entrusted to her to soak, just as we do of the linen which we send every week to the laundress. And then "The Angler's Register" will be found convenient for entering what cables have been grappled for and fished up from time to time, whether whole or in fragments. It seems a pity that "The Angler's Guide," or "The Complete Angler," is not also included in the catalogue. That might have given us information as to the best baits, ground and bottom, for catching lost lengths, and even have recommended killing flies for every month in the year, which would save a world of trouble and expense by "rising" such lengths or ends to the surface, where they might be netted or gaffed according to size and weight.

Des Paratonnerres à pointes, à conducteurs et à raccordements terrestres multiples. Par MELSENS, Membre de l'Académie Royal des Sciences de Belgique. F. Hayez, Bruxelles.

THE object for which this work is written, is the description of the system of lightning conductors established on the Brussels Town Hall. Curiously enough, there is no record of any damage having been done to the building by lightning previous to the ninteenth century, though since that period injury has been done on several occasions, and notably in 1860 and 1863.

The conductors on the edifice appear to have been erected in a most substantial and scientific manner, and the diagrams in the book show well how the work has been executed.

Apart from being a descriptive volume, the book is very useful, as it brings together the opinions on the general subject of a number of eminent authorities.

Notes.

AT the general meeting of the Society of Telegraph Engineers, on the evening of Wednesday, January 23, the splendid electric light, of 1,200 candles intensity, produced by a magneto-electric machine of Messrs. Siemens, commanded the admiration of all. The light from the glowing carbon points was reflected upwards upon a screen of white linen suspended from the roof, and thence reflected down again upon the auditory. It was curious to observe the fleecy whiteness of the screen when the light played upon it, a diffused whiteness resembling that of a sunlit cloud, or the surface of new-fallen snow; and we can recommend it as a theatrical effect or as a source of diffused light in photography. Besides the electric light, a bichromate cell, invented by Dr. Burns, an American, and yielding a current whose strength is extraordinarily increased by pumping air into the liquid by a hand syringe, was exhibited, as also a piece of Edison phonograph slip, with recorded speech upon it. The slip was of tin-foil, and covered with minute indentations. The address of the President, Dr. Siemens, was listened to with marked attention; but it was rather to be regretted that some notable advances in telegraphy were left unnoticed, such as the duplexing of ocean cables by Muirhead's Artificial Line, and the working of cables by means of Thomson and Jenkin's Curb Sender.

THE announcement of the resignation by Mr. W. Langdon, of the office of Acting Secretary to the Society of Telegraph Engineers, will be received with very great regret by all connected with the Society. It will be extremely difficult to find a successor who will prove such an energetic and efficient secretary as Mr. Langdon has been.

NEW ELECTRICAL LAW.—Clausins announces the following general law, of which many of the known laws of electrical reciprocity are immediate consequences. Suppose there to be any number of conductors c_1, c_2, c_3, etc., which mutually influence each other; let them receive two different charges of electricity. At the first charge, let the respective quantities in the different bodies be Q_1, Q_2, Q_3, etc., and the resulting potentials v_1, v_2, v_3, etc. At the second charge let the corresponding values be Q_1', Q_2', Q_3', etc., and v_1', v_2', v_3', etc., then we shall find $v_1 Q_1' + v_2 Q_2' + v_3 Q_3' +$ etc., $= v_1' Q_1 + v_2' Q_2 + v_3' Q_3 +$ etc., or taking the sums, $\Sigma v Q' = \Sigma v' Q$.—*Annalen d. Phy. u. Chim.*

THE French postal and telegraph services are to be united and placed under the directorship of M. Cocheris, a well-known writer on political economy.

THE TELEPHONE AT OSBORNE.—On the evening of Monday, January 14th, Professor Graham Bell had the honour of exhibiting to the Queen the marvellous capabilities of the telephone. The trial took place in the Council Chamber of Osborne House, Isle of Wight, in presence of Her Majesty, the Princess Beatrice, the Duke of Connaught, and others of the Court. A temporary line three-quarters of a mile long had been erected between Osborne House and Osborne Cottage, the residence of Sir Thomas Biddulph, and the experiments began by the Princess Beatrice speaking with Lady Biddulph. At Osborne Cottage Miss Kate Field, the well known vocalist, sang "Kathleen Mavourneen," "Coming through the Rye," and the "Cuckoo Song," then recited the epilogue of *As you like It*, all of which were distinctly heard by the Royal party, and so well appreciated that the Queen thanked the singer personally through the telephone. Communication was then established with Cowes, where Major Webber, R.E., was superintending. Here several part songs were sung by a quartet, and plainly heard at Osborne. At Southampton, which was switched in circuit somewhat later by Mr. W. H. Preece, a bugle call sounding the "Retreat," fell on the hushed ears of the assembly in the Council Chamber like a distant echo, and produced a stirring impression. It is remarkable that, whereas for ordinary speech or music the ear requires to be close to the telephone in order to hear anything at all, the bugle note was heard by everyone present, though standing several yards from the receiving telephone. At the conclusion of the experiments, London was connected up to Osborne, and tunes played on Mr. Bell's telephonic organ in London were plainly heard by the Royal party. The experiments lasted from half-past nine to twelve o'clock. The arrangements at Osborne were made by Messrs. Ormiston and Chevallier, of the Silvertown Telegraph Company. On the following day, some further trials were made in presence of the Royal household, and several of her Majesty's ministers.

TELEPHONE-IANA—A MAKESHIFT TELEPHONE.—In a recent lecture at the London Institution, Professor Barrett mentioned that a cheap, makeshift telephone could be made from an empty tooth-box, by making a hole in the bottom, about the size of a half-a-crown, and fixing over it a disk of sheet iron (such as can be cut from the lid of a meat-tin) by means of the cover of the box. A small bar magnet having an ordinary thread reel wound with insulated wire stuck on one pole, completed the necessary parts of the contrivance. Professor Barrett stated that with telephones made in this way he had been able to converse over a distance of 100 yards.

A TELEPHONE WITH SEVERAL AUDITORS.—Professor John McKendrick, writing from the Physiological Laboratory, Glasgow University, to *Nature*, says that "in endeavouring to utilize one telephone by making several friends listen at once, I have found that by fixing the metal disc to a thin membrane over a small cavity, filled with air, like Kœnig's capsule, and having a number of flexible tubes connected with it, an ear placed at the end of each tube will hear distinctly.

No less than eleven different patents for telephonic apparatus were taken out in England from November 20 last year to January 15th. Among the patentees we observe the names of Professor Graham Bell, Professor Fleming Jenkin, and also Dr. E. W. Siemens. One of the patents (Mr. Pritchett's) relates also to phonographic apparatus.

THE TELEPHONE AND "ELECTRIC PEN" IN RUSSIA.—M. Sergins Kern reports in the *Chemical News* that the telephone is also the great novelty of the day in Russia, where several firms are selling them at £1 a-piece, a price which is considered there to be too high. We wonder what the Russians would think of the price charged in England—£25 and £35 a pair. M. Kern also states that the diffusion of Edison's electric pen is much checked by Government regulations, as the use of printing implements for private study is strictly forbidden in Russia.

AT a recent meeting of the Medical and Physical Society of Würzburg, Professor Fick showed a curious effect of the articulating telephone currents on the prepared limb of a frog. The two terminal wires of a telephone were placed in contact with the leg muscles of the frog, and on speaking into the instrument the limb was seen to twitch itself. The vowel sounds *a e i* had scarcely any "ranëic" effect; whilst *o*, and especially *u*, on the other hand, produced a most violent convulsion. The command "Liege still," in a loud voice, had hardly any effect; whereas the word "Tucker," even in a low tone, caused the limb to jerk forcibly. These experiments serve to remind us of the original observation of Galvani, and the remarkable progress of electrical science since his day.

HUGHES' APPARATUS.—M. Christiani, telegraph secretary in Berlin, from a consideration of the Bell telephone, has been led to employ the magneto-induction currents of a Hughes' Apparatus to put a second Hughes' at a distance into action. He found it possible to work with certainty through 120 kilometres of cable.

AN interesting note on Edison's telephone has been communicated to the Academy of Sciences, Paris, by M. Bréguet, on behalf of MM. Garnier and Pollard, engineers of naval construction Cherbourg. Wishing to realise the effect of Edison's plumbago telephone, these experimenters took a little plate of sheet-iron like the disc of Bell's telephone, and pointed against it the end of a pencil of plumbago, so that the pencil point pressed lightly on the centre of the plate. The pencil on the one hand, and the plate on the other, were connected to the two terminals of an ordinary Bell telephone, in which a bar of soft iron took the place of the magnet. A battery of ten Leclanché elements was inserted in the circuit. On speaking so as to throw the plate into vibration the end of the plumbago style underwent a series of changes of pressure from the plate without the contact being broken between them. These variations of pressure were attended by corresponding variations of resistance in the pencil, and consequently by modulation in the current in the circuit. These current changes in turn caused the disc of the Bell telephone to vibrate and give out the sounds spoken beside the transmitting plate. This union of Bell's and Edison's telephones may lead to louder utterances on the part of the former.

MR. EDISON has invented a larger speaking phonograph, which is capable of being heard at a distance of 175 feet.

JABLOCHKOFF'S ELECTRIC CANDLE.—From recent experiments with this electric wick, it appears that its cost as compared with the ordinary carbon sticks stands greatly in its way as a rival of the latter. A candle 0·12 metre long burns half an hour, giving out a light equivalent to 250 candles, and costs 50 centimes. A light equivalent to 1,000 candles, lasting an hour, would therefore cost 4 francs for the wick alone, apart from the cost of working the magneto-electric machine. With the ordinary carbon points and regulator, the same light can be maintained at a cost of only 2½ centimes, from the consumption of about one-tenth of a metre of the points.

ALUMINIUM IN TELEGRAPHY.—The *D. Allg. Poly. Zeitung* draws attention to the fact that aluminium has double the conducting power of iron, and being also tough can be made into very slender wires. Owing to its extreme lightness, line wires of aluminium would be especially suitable for military telegraphy service; great lengths could be easily transported. The difficulty of producing it in quantity is against its application for the purpose in question; but it is thought that the mineral oryolite, which is abundant in Greenland, would furnish plenty of the raw ore from which the metal might be reduced by smelting. An alloy of aluminium and iron might become useful as a material for telegraph wires.

IT is not, we think, generally known that aluminium is highly magnetic, as well as a good conductor. In telegraphic apparatus having movable coils, actuated by the passage of a current, aluminium from its lightness and good conductivity, would seem to be eminently fitted, and we believe that it has already been applied by Messrs. Siemens, Berlin, as the wire for the coil of their new recorder.

ELECTRO-GILDING BY MEANS OF FERRO-CYANIDE.—*Dingler's Polytechnischer Journal* gives the following process of Herr Ebermayer for electro-gilding. The bath is prepared by making a solution of 300 grammes of ferro-cyanide, 100 grammes of carbonate of potash, and 50 grammes of sal-ammoniac, in 4 litres of water. To this solution are added 200 cubic centimetres of a

second solution, formed by dissolving 100 grammes of gold in aqua-regia, driving off the excess of acid and dissolving the chloride of gold so formed in water, so as to make up a litre. The mixture of the first and second solutions takes a blue colour, which disappears on boiling, whilst ferric oxide is precipitated. The liquid when cooled, filtered and made up to 5 litres is the gilding bath. As it is a bad conductor and deposits ferric oxide upon the electrodes, a small quantity of cyanide, not sufficient to evolve hydrocyanic acid on boiling, is added. The gilding is done, performed at a temperature of 40° to 50° C. When the bath ceases to yield a good deposit, another 200 cubic centimetres are added as before, until all the gold is used up. If the bath is to be employed for further quantities of gold, one-tenth of the quantities of salt above prescribed must be added to the bath. The advantage of the above process lies in avoiding the use of large quantities of cyanide of potassium, which is objectionable on sanitary grounds.

A CONSTANT DANIELL CELL.—In the *Philosophical Magazine* for January, Dr. Oliver J. Lodge describes a form of Daniell cell, without a porous partition, in which diffusion of the sulphate of copper and sulphate of zinc solutions is so retarded as to keep the cell practically constant in electro-motive force. The plan consists in enclosing strips of the two metals, zinc and copper, each in its own separate test tube, and immersing the two tubes lashed together by silk thread into a vessel containing a solution of sulphate of zinc. The tube into which the copper strip dips, though open at the top, is closed at the bottom, so that the sulphate of zinc solution only gains access to it by the top. On the other hand the tube enclosing the zinc strip is open at the bottom, so that the sulphate of zinc only gets into it there. A few crystals of sulphate of copper lie at the bottom of the copper tube and dissolve there. The ends of the metal strips are carried up outside the external vessel to form the poles of the cell. The special advantage in this arrangement consists in the fact, that in order for the sulphate of copper solution to make its way to the zinc plate it must diffuse up out of the copper tube, and downwards through the sulphate of zinc solution, then upwards through the zinc test tube. The resistance of such a cell is, however, very high. The tubes can be arranged so that no diffusion at all takes place by raising the copper tube up so that its edge, which should be damp, is about one quarter inch above the surface of the zinc solution in the vessel. The electrical connection is maintained by the moisture, or film of zinc salt, on the glass surface of the top edge of the tube, while diffusion is prevented. The only change which can go on in such a cell is the concentration of the zinc solution, and that can be kept in check by drawing off the solution with a pipette, and replacing it by fresh water from time to time. Dr. Lodge proposes the latter form of cell as a standard of electro-motive force.

WHEATSTONE'S VIOLINCELLO.—In a letter to the *Athenæum* on the "Origin of the Telephone," Mr. William Chappell relates an amusing anecdote in connection with Wheatstone's early researches on the transmission of sound. "One of Wheatstone's earliest discoveries," says Mr. Chappell, "(one long before his electric telegraph), was that all the varying sounds of musical instruments might be conveyed to considerable distances by means of solid rods joined together. It was only necessary to bring the end of the topmost rod sufficiently near to the instrument to receive its vibrations without touching it. An eminent foreign musician, a violincello player, coming to England, brought a letter of introduction to Wheatstone. He left the letter at his house and appointed to call again at a particular hour on the following day. Wheatstone was at home to receive him, and, thinking to surprise and to amuse his visitor, he hung a violincello on the wall of the passage, having a rod behind it to connect it with another which was to be played from within when he entered the hall. Wheatstone told me that his guest turned in every direction to find whence the sound came, and, at last, approaching the violincello hanging on the wall, and having satisfied himself that they proceeded from it, although there was neither hand nor bow to play upon it, he rushed out of the house in affright, and would never enter it again."

A GERMAN paper gives a detailed description of the apparatus designed by Captain Buchholtz, of the Prussian railway regiment, and recently adopted in the German army, for providing telegraphic communication between the different fractions of an outpost line, or between the outposts and the main body of an army in the field. The whole apparatus consists of two small Morse's receiving instruments, a Siemens' and Halske battery, and a cable about three millemetres in diameter. It being impossible with a movable apparatus to use the earth to complete the electric circuit, a return wire is provided in the cable. An ingenious but extremely simple arrangement has also been devised for joining lengths of the cable together; the operation being rendered so simple that it can be performed by any one without any previous instruction or practice. The cable itself is manufactured in lengths of 500 metres, each being carried on a reel, which fits into a havresack in such a way that, as the man carrying it walks forward the wire unrolls itself behind him. The cable can therefore be laid as quickly as a man can walk. The receiving instrument is fitted in a small box, on the outside of which is the sending key and a bell. The weight of the box, which also contains a small galvanometer, is about 8 lb., and it can be carried in front of a man by means of a strap across the shoulder. The battery is carried in another box, and consists of ten elements, the whole weighing about 22 lb. It will act for months without the materials being renewed, all that is necessary to keep it in order being to add to it occasionally a few crystals of sulphate of copper and

a little water. The whole apparatus is to be carried in time of war on one of the waggons accompanying the battalions of infantry, and, when required for use, will be given to the men who are to employ it in exchange for their packs.

Patents.

4855. "Improvements in transmitting, receiving, and printing telegraphic messages, and in the apparatus employed therein, or connected therewith."—F. J. BOLTON, Dec. 24, 1877.

4903. "Magneto-electric machines"—W. R. LAKE (communicated by E. Weston), Dec. 27, 1877.

4934. "Improvements in electric telephony, and in telephonic apparatus."—C. W. HARRISON, Dec. 29, 1877.

58. "Electric telephones or apparatus for transmitting sounds."—G. STEPHENSON, Jan. 4, 1878.

125. "Improvements in and appertaining to telegraph alarm apparatus (to be known as the telmoreal)."—W. P. THOMSON (communicated by S. Mohr), Jan 10, 1878.

131. "Improvements in the construction of electrical cables, so as to protect the cores of such cables from the destructive action of marine and subterranean insects."—D. GÖLLNER, Jan. 10, 1878.

143. "Improvements in signal lights, to be used for military or other purposes."—R. N. COURTENAY, Jan. 11, 1878.

160. "Improvements in transmitting signals on board ship and in other vessels or situations and in apparatus therefor."—T. BASSNETT, Jan 12, 1878.

162. "Improvements in and relating to the production of magneto-electricity and the application of the same to telephonic or telegraphic purposes and in apparatus therefor (complete)."—W. R. LAKE (communicated by J. Mc. Tighe) Jan. 12, 1878.

191. "New or improved means and apparatus or appliances for utilising and conveying sounds or signals from or to telephonic or phonographic sound producing or signalling instruments."—G. E. PRITCHETT, Jan. 15, 1878.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

76. "Improvements in the insulating supports of telegraph wires."—JOHN CRISP FULLER and GEORGE FULLER, dated Jan. 8, 1877. 6d. This invention is fully described in the *Telegraphic Journal*, No. 118.

118. "Improvements in electric telegraph apparatus delivering printed messages."—JAMES WYARD GOOCH, dated Jan. 10, 1877. 6d. This relates to a type printing telegraph apparatus in which the sending and receiving instruments are rendered synchronous in their action by clockwork; also an arrangement whereby several receiving instruments may receive independently of each other when connected to the clockwork of one sending instrument.

121. "Improved means for lighting gas."—PIERRE DRONIER, dated Jan. 10, 1877. 6d. This consists in lighting gas by bringing it into contact with a platinum wire heated red hot by electricity. Provisionally protected only.

127. "Improvements in the means and apparatus for telegraphing; applicable also for registering or recording electrical action."—SIR JAMES ANDERSON, HENRY NICHOLSON, BLACKWOOD-PRICE, and HENRY GEORGE CHEESEMAN, dated Jan. 10, 1877. 6d. Recording telegraphic signals by the movement of a ray of light or sensitised paper. Provisionally protected only.

160. "A new electric automatic indicator for electric bells, for house telegraphy, and other purposes."—THEOPHILUS COAD, dated Jan 12, 1877. This consists in fixing a regulator to the armature of the bell indicator, so as to give the armature a longer or shorter period of oscillation. *(Not proceeded with.)*

197. "Improvement in multiplex telegraphs."—A communication from G. B. PRESCOTT, U.S., dated Jan. 15, 1877. 1s. This consists in a full description of Messrs. Prescott and Edison's quadruplex system.

270. "Improvements in apparatus for generating electricity."—CROMWELL F. VARLEY, dated Jan. 10, 1877. 8d. This invention has for its object the production of electricity, by which electrostatic discharges and dynamic currents of sufficient potential to generate ozone, produce chemical decomposition, the electric light, and other electrical effects, can be obtained and maintained when desired, as in the production of the electric light. It consists of a magneto-electric machine for generating currents, and an improvement on the author's machine (described in Patent No. 206, 1860), by which accumulating charges are stored upon inductive surfaces and on rotatory dielectrics so as to enable sparks of considerable length to be obtained. These sparks are employed in the electric light to re-establish the circuit between the carbon points when accidentally or momentarily interrupted. The magneto-electric machine and electrostatic multiplier are employed together in producing the electric light. The machine gives rise to an electric arc between the carbon points, and the multiplier renders it constant by placing its poles close to the carbon holders so that a stream of sparks may pass to them constantly so long as the light is being maintained. The high tension electricity, which in this manner is caused to pass between the carbon points, maintains the magneto-electric discharge.

302. "Improvements in galvanising and metal coating apparatus."—JOHN LYSAGHT, January 24, 1877. 6d. This consists in forming the pots with flues passing through them so as the better to maintain uniform temperature in the molten zinc used for galvanising. Other improvements consist in forming the pots with a channel at the bottom within which the furnace is constructed, to the rollers employed in the manufacture of galvanised iron, and to the insertion of movable receptacles, for hard spelter or other deposits, into the bottom of the pots.

374. "Improvements in transmitting and telegraphic messages, and in apparatus therefor, and also in type-writing processes and in apparatus therefor."—SAMUEL PHILLIPS, Jan. 29, 1877. 6d. This consists in a means for transmitting words as fast as they can be uttered, and recording them in a multiple form if required, at both ends of the line in Roman type, as printed, and also in a means whereby short-hand characters traced at either end of the wire are instantly translated into Roman printed letters. Both results are produced by a set of electro-magnets corresponding to the letters of the alphabet actuating type so as to print. The mechanism is synchronous at both ends of the line. Simple movements in manipulating, such as are necessary in making short-hand characters, can be translated by the mechanism into printed letters.

421. "Improvements in electric logs for measuring the speed of vessels."—J. P. HAINES, U.S., Jan. 31, 1877. 6d. This consists in the employment of a flexible diaphragm of india-rubber to separate the chamber containing the terminal wires of the circuit from the chamber containing the mechanism of the log, so as to exclude water from the terminal chamber. A lever arrangement actuated by the vane of the log pushes a rod, which passes through the india-rubber diaphragm against the terminal wires so as to cause them to make contact as each unit of distance is traversed by the ship. The contact establishes a current indicating circuit between the log and the ship, and the distance made is recorded on board.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

Sir,—In your No. 110, Mr. Thomas T. P. Bruce Warren says as follows:—

* * * * * *

"The cables and core made by Mr. Hooper for the India Government are considered monuments of success, for we must not overlook the important fact that experience had to be gained in the manufacture of india-rubber cores as with gutta-percha, and yet where decided and continued failures had to be recorded with the earlier gutta-percha cables, the very first length of india-rubber cable manufactured continues to work to this day. It is but fair to point out that the faults which were heard of some time since in the Persian Gulf india-rubber cable were not in any way due to a failure of the material. I do not hear such good accounts of the india-rubber cable laid between Ceylon and the mainland of India. This piece, I understand, is very much lower in insulation than when manufactured—in fact its dielectric resistance is expressed by saying that it still works! I am, however, not able to confirm what has been said with respect to certain individual faults cut from this cable, although I believe them to arise from avoidable causes.

"Now we must measure these facts not only as against our present knowledge of what has been done, or what india-rubber is capable of being brought to, but with the fact that attempts were made twice to maintain communication between Ceylon and the mainland by means of gutta-percha, both of which resulted in failure in about as many months as may be counted in years with the india-rubber core."

* * * * * *

It is quite true that the insulation of the india-rubber cable between Ceylon and India is very low. See the following table:—

	Insulation resistance, per knot. megohms.
When laid January, 1867	7,000
September, 1871 (next test)	22·9
December, 1876 ... ... about	0·4

However, I do not know what Mr. Warren means by "certain individual faults cut from this cable," because the cable has never been cut or touched since it was laid, and all the tests which have been taken shew that the cable has deteriorated throughout, and that there are no special faults in it.

Only *one* attempt was made to maintain communication between Ceylon and India by means of gutta-percha, viz., by the cable laid in 1857, and this was so far successful that the cable worked without a single interruption not only a few months but until 1866, about 10 years, when it failed. Its failure was the cause of the india-rubber cable, above named, being laid, which has lasted 11 years (i.e., one more year than the gutta-percha cable) but is likely to fail any day. The failure of the gutta-percha cable was probably not due to any fault of the gutta-percha, but to its great mechanical unfitness for the place in which it was laid. All enquiry and examination have tended to shew the gutta-percha was not in fault.

Yours truly,
W. REES PHILIPPS,
Assistant-Superintendent Telegraphs.

Madras, 7th November, 1877.

To the Editor of THE TELEGRAPHIC JOURNAL.

Sir,—My attention has been called to a note in your number for December 15, commenting on some article which your contributor ascribes to my pen. As his remarks are somewhat petulant, not to say peevish in tone, it would have been well if he had in the first instance assured himself that I really was the author of the article in question. As I have never written any article on the "New and wonderful Phonograph" in a public newspaper, your contributor who discourses so glibly about the mistakes of others, must in this instance have made a slight mistake himself. Neither have I written in the *Nineteenth Century* as he states; nor, again, has the "Manufacture of Soap" been made a subject for my pen. The note further refers to some former diatribe of his on a remark of mine, about a possible extension of the powers of the telephone. He should know, however, that that remark was based on a statement of Sir W. Thomson's, who although not a professional electrician, has been able as a scientific electrician to show professionals the possibility of several things they had deemed absurdly impracticable.

I presume your contributor's objection to the passage he wrongly attributes to me is based on the use of the fanciful words "crystallization of sound," because, so far as the possibility of obtaining a material record of sound is concerned, there is no longer any room for doubt or question.

An essay on Mr. Edison's invention recently appeared in the *Spectator*, to which I sometimes contribute. It is not mine, however. Let me add that no unsigned articles appearing in any journal where a writer *can* append his name, come from my pen.

Faithfully yours,
RICHARD A. PROCTER.

To the Editor of THE TELEGRAPHIC JOURNAL.

Sir,—I have a weakness, and that is a dislike to seeing my inventive chicks fathered on someone else.

A little matter that I worked out in Italy some two years ago, and which, since I published the method in the *British Journal of Photography*, has come largely into use, is described under an article on Photography in your issue of December 1, as part of a "New System of Photography" introduced by Messrs. Wratten and Company.

The parts marked* in the enclosed are those described first by myself, as I have stated; and I think you will see the justice of my remarks. Yours truly,
WALTER B. WOODBURY.

South Norwood, S.E.
January 14, 1878.

* "The film can then be removed to a piece of prepared paper, and, when dry, stored in a book until the traveller's return home, when with great ease it may be again superimposed on glass for printing. This method of removing each day's negatives from the glass to paper presents two advantages: firstly, the negatives can be safely carried, and in a light bulk; and secondly, six pieces of glass will serve for the production of an indefinite number of negatives."

TELEPHONE.—Descriptions of the various kinds of telephones are contained in Nos. 69, 79, 97, 102, 108, 109, 110, 111, 115, 116, 117, 118, of THE TELEGRAPHIC JOURNAL—[ED. TEL. JOUR.]

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

THE opening meeting of this society for the present year, was held at the Institute of Civil Engineers, 25, Great George St., Westminster, on the evening of Wednesday the 23rd ult.

The chair, at the opening of the meeting, was taken by the retiring President, Professor Abel, F.R.S., who introduced the new President, Dr. C. W. Siemens, F.R.S., D.C.L.

The minutes of the previous meeting having been read and confirmed, the Secretary read a list of new candidates for election into the society.

The President then rose to deliver his inaugural address of which the following is a summary:—

The President commenced by remarking that when he delivered his first address, six years ago, the society was composed of only 110 members of every description. This number has now reached up to nearly 1,000 members.

The six volumes of transactions issued by the society since its origin are proof of its activity as a scientific institution, whilst its status has been much advanced through the establishment of a valuable scientific library, bequeathed in trust by the late Sir Francis Ronalds.

The subject of Duplex Telegraphy and the progress it had made under C. A. Nyström of öreboro, Sweden, Dr. Gintl of Vienna, Frischen, Dr. Werner Siemens, Mr. Stearns of Boston, and Mr. Louis Schwendler was first noticed.

The quadruplex telegraph, which may be considered to have been theoretically introduced by Dr. Stark, of Vienna, in 1855, and contemporaneously by Dr. Boscha of Leyden, and which has been developed by Mr. Edison of New Jersey, U.S., was next drawn attention to, and the possibility of further combinations of the same nature, for six or eight pairs of instruments, pointed out. The success of these improved methods of transmission depends almost entirely upon the perfect insulation and undisturbed condition of the line-wire, a subject which has yet to receive much attention on the part of the telegraph engineer.

Attention is next drawn to the great novelty of the day, the Telephone.

This remarkable instrument owes its origin to the labours of several inventors.

In the year 1859 the late Sir Charles Wheatstone devised an arrangement by which the sounds of a reed or tuning-fork, or a combination of them, could be conveyed to a distance by means of an electric circuit, including at both stations a powerful electro-magnet. In striking any one of the tuning-forks differential currents were set up which caused the vibration of the corresponding tuning-fork at the distant station, and thus communicated the original sound. In 1862 Reiss enlarged upon this ingenious suggestion in attempting to convey the varying vibrations of a diaphragm agitated by atmospheric sound-waves.

This instrument transmitted currents only of equal intensity, and was quite incapable of transmitting the human voice.

These defects in the instrument of Reiss have been remedied by Mr. Edison, who, by establishing contacts through the medium of powdered plumbago, has succeeded in transmitting galvanic currents varying in intensity with the amount of vibration of the diaphragm.

As another step towards the accomplishment of the perfect transmission of sound, may be mentioned also the logograph, or recorder of the human voice, which Mr. William Henry Barlow, F.R.S., a member of the society, communicated in a paper to the Royal Society, on the 23rd February, 1874.

In adding a contact arrangement to the recording pencil of Mr. Barlow's instrument, the message could obviously be transmitted to a distance to be recorded there either by graphical or audible signals.

The beautifully simple instrument of Professor Graham Bell, of Cambridge, U.S., must be regarded as a vast step in advance of all previous attempts in the same direction. In making the diaphragm of iron, and having recourse to Faraday's great discovery of magneto-induction, Mr. Bell has been able to dispense with the complication of electrical contacts and batteries, and to cause the vibrations of the diaphragm imparted by the voice to be accurately represented in strength and duration by electrical currents.

The currents transmitted are so minute as to escape observation by the most delicate galvanometer, as the magnetic needle, however light, must be too sluggish to be moved visibly by such quick impulses, and it requires an electro-dynamometer of exceeding sensitiveness to bring them into evidence. Mr. Köntgen concludes from experiments he has made with a high pitched tuning-fork that not less than 24,000 currents can be transmitted in one second. We here detect a rapidity of electrical transmission far exceeding our most sanguine expectations in endeavouring to increase the rate of transmission of telegraph instruments by mechanical means, thus opening out a new field for the inventive faculties of the telegraph engineer.

The telephone is no doubt capable of great improvement, which should chiefly be directed towards increasing the relative amount of vibration of the receiving diaphragm.

Improvements will doubtless be directed also towards the accomplishment of simple methods of recording the audible messages received, which has already been attempted by Mr. Edison.

Considering the minuteness of the electrical impulses and their high electro-motive force, it seems probable that they will be capable of being transmitted to very great distances through conductors of comparatively small dimensions, provided only that those conductors are not subjected to the disturbing influence by induction of currents flowing through adjoining wires.

The system of suspended line-wire now generally in use is open to many grave objections. The remedy for these is undoubtedly the underground line-wire system. This was first tried in Germany upon an extended scale in 1848-49, but was given up in favour of the suspended line in consequence of the want of experience in manufacture and imperfect protection afforded to the gutta-percha covered copper wire. Since then it has been largely used in this country for underground communication in cities, also for aerial lines, by suspending a bunch of the insulated conductors by steel wires in the air, as we see them supported on the house-tops of this metropolis.

In Germany underground cables of an aggregate distance of 600 miles have been laid, while further extensions are in course of execution. These cables consist of seven separate conductors, each insulated with gutta-percha, surrounded with a complete iron sheathing and a double outer covering consisting of hemp steeped in asphalte, producing altogether a

flexible cable of 1¼ inches outer diameter, which is laid along railways or roads at a depth of about 3 ft. below the ground.

In submarine telegraphy no startling feat of novelty can be reported, although steady progress has recently been made in improving the manufacture of the insulated conductor, in the attainment of an increased rate of transmission through long distances, in the outer protection given to the insulated conductor, and in the vessels and other appliances employed for submerging and repairing deep-sea cables.

The careful selection of the insulating material employed has also an important influence upon the rate of transmission through long cables, as it is found that different kinds of gutta-percha behave very differently in this respect. India-rubber has, it is well known, considerably less inductive capacity than gutta-percha, and appears on this account the preferable material, but its application to the conductor, without the risk of faults and of gradual changes in the condition of the material, is beset with considerable practical difficulty which has as yet limited its application. Compounds of india-rubber and gutta-percha, with other materials such as shellac, paraffin, and bitumen, have been proposed from time to time with promising results, but it has been impossible hitherto to give to such compounds all the properties necessary in the dielectric substance covering the conductor, viz., a low inductive capacity and high insulation, coupled with considerable toughness and permanency at all ordinary temperatures, and the requisite plasticity at higher temperatures. The supply of gutta-percha has hitherto been sufficient for the demand, but a large extension in the use of insulated conductors both by sea and land will, it may be apprehended, outrun the supply, and it is well on this account that we should steadily fix our attention upon such compounds as are likely to furnish a suitable substitute.

Regarding a continued supply of gutta-percha and india-rubber it is satisfactory to observe that the Indian Government have turned their attention seriously to the question of making plantations of trees bearing these gums, chiefly in the Malay Peninsula, under the able direction of Sir Joseph Hooker, and of Dr. Brandes, the Director of the Forest Department in India.

The outer covering now generally applied to shallow-sea cables consists of a sheathing of iron wire covered with a double layer of hemp steeped in asphalte, and applied to the cable in a heated condition, and this, if properly carried out, affords very efficient protection for the iron sheathing against corrosion.

In the construction of deep-sea cables, steel wires are generally used, each wire being covered in the first instance with jute with a view to reduce the weight of the cable. This construction affords the advantage of lightness combined with strength, but is objectionable, inasmuch as it affords no complete metallic sheath against the inroads of the Teredo and Xylophaga to the core, and, in the case of a cable having to be raised from considerable depths, it is apt to untwist, and run itself into kinks at the bottom.

The use of a light cable for deep seas has been ably advocated by some electricians, and its adoption has the one great argument in its favour, that its first cost is much below that of a strong cable; on the other hand the risk incurred in successfully submerging such a cable is much greater, and in the case of a fault appearing in deep water it will be hopeless to bring the light cable to the surface for the purpose of repair. It is possible that the manufacture of cables will be made a matter of such absolute certainty that the case of faults making their appearance in submerged cables may be left entirely out of consideration, but in the meantime telegraph companies have given the preference, and wisely so, to a cable which though more costly than its light competitor affords a greater security to their property in case of an accident or a fault.

But little discussion has as yet taken place of the best means for effecting the repair of cables after submersion. The important primary condition towards effecting the repair of a submerged cable is that its general insulation should be perfect, without which it would be impossible to determine the position of a break or fault with any degree of accuracy. Another important condition is the possession of a cable-ship furnished with special facilities for manœuvring, which the vessels ordinarily employed do not possess.

The transmission of telegraphic messages through long submarine cables is a subject which was at one time involved in great practical difficulty owing to the retardation by lateral induction experienced by the electrical current in its transit. It is to our past president, Sir William Thomson, that we are indebted for a solution of this difficulty, through the application of his celebrated mirror instrument, and his syphon recording instrument. This latter instrument, however, is of a somewhat delicate and complicated nature, and it would be desirable if its place could be taken by a relay of extreme sensitiveness, coupled with ordinary recording instruments worked by local circuits, the accomplishment of which result we may anticipate before long, considering the great improvements that have been effected in the construction of polarised relays.

It has lately been asserted that other countries, and especially the United States, are now taking the lead in telegraphic improvement. It cannot be denied that the more startling innovations of recent days have chiefly emanated from the United States, the only civilised country in which, as it happens, internal telegraph communication is still in the hands of private companies; and this open competition has no doubt been the stimulant—a stimulant which was equally active in this country in producing a variety of novel instruments at the time prior to the purchase of the telegraphs by the Government.

By this expression of opinion, the wisdom of the policy, which dictated the purchase on public grounds of the telegraphs by Government, is not called in question. Through it we have obtained a uniform and moderate tariff, and an extension of the telegraph system to minor stations. It is a question worthy of consideration whether the Acts of Parliament of 1868-69, by which the Government Department of Telegraphs was created in this country, do not go beyond the limits necessary to insure a well-regulated public service in taking the construction as well as the working of the lines out of the hands of public enterprise. They give, for instance, to the Department the faculty of purchasing letters patent, whereby an interest is created in favour of particular instruments, to the prejudice of others of perhaps equal merit, and such a course is by no means calculated to stimulate invention.

The erection of lines for local and private purposes is an important branch of telegraphy which should have remained entirely outside the scope of a public department, in order that competition might have a free opportunity of developing such applications, as is the case in the United States, where private and circular telegraphy is undoubtedly in advance of other countries.

Not that the officers of the Postal Department have been remiss in their efforts to improve the working of

the lines, for great improvements have indeed been recently made by the Postal Telegraph Department in the rate of working of Wheatstone's automatic circuits, and in the employment of fast-speed translators or repeaters. These instruments have improved the rate of working between London and Dublin about 50 per cent.

In submarine telegraphy ample scope still exists for the ingenuity and enterprise of the telegraph engineer; but here again the free exercise of these faculties is threatened, not by legislative action, but by a powerful financial combination. It is intended by this combination to merge the interests of all oceanic and international lines and the construction of new lines into one interest, to the exclusion of that wholesome competition for excellence, without which true progress is practically impossible. It seems hardly probable that such a monopoly will be able to maintain itself in the long run against that irrepressible spirit of British enterprise, which, though languishing at the present time of unparalleled depresssion, is likely to re-assert itself before long.

Much has been said about the application of electricity for producing light, but the complete realisation of all the advantages of the electric light remains a problem to be solved, and it would be extravagant to expect from applications on a small scale such as have hitherto been made anything like the amount of relative advantage indicated by theory.

The dynamo-electric machine besides being used for the light has been applied with considerable success to metallurgical processes, such as the precipitation of copper in what is termed the wet process of smelting. The effect of one-horse power expended in driving a dynamo-electric machine of suitable construction is to precipitate 1120 pounds of copper per 24 hours, equivalent to an expenditure of 72 pounds of coal, taking a consumption of 3 lbs. of coal per horse-power per hour.

Electrolytic action for the separation of metals need not be confined however to aqueous solutions, but will take perhaps an equally important development for the separation in a state of fusion of the lighter metals, such as aluminium, calcium, and some of the rarer metals, such as potassium, sodium, &c., from their compounds, as has been shown by Professor Himly of Kiel.

Experiments have been made with dynamo-electric machines with a view to ascertain the percentage of power that may be utilised at a distance, and the results of these experiments are decidedly favourable for such an application of the electrical conductor. Above 40 per cent of the power expended at the distant place may be recovered: the 60 per cent. lost in transmission includes the friction of both the dynamo-electric and electro-motive engines, the resistance of the conductor, and the loss of power sustained in effecting the double conversion. This amount of loss seems considerable, and would be still greater if the conductor through which the power were transmitted were of great length and relatively greater resistance; but on the other hand it must be remembered that the power of a natural motor is obtained without expenditure of coal, and that a small caloric motor which the electric motor is intended to supplant is inconvenient and very extravagant in fuel.

In conclusion, Dr. Siemens said, that Electricity, which in the days of Franklin, Galvani, Volta, and Le Sage, was regarded as an ingenious plaything for speculative minds, and did not advance materially from that position in the time of Oersted and Ampère, of Gauss and Weber, and not indeed until the noonday of our immortal Faraday has, in our own times, grown to be the swift messenger by which our thoughts can be flashed either overland or through the depths of the sea to distances, circumscribed only by terrestrial limits. It is known to be capable of transmitting, not only language expressed in conventional cypher, but facsimile copies of our drawings and handwriting, and at the present day even the sounds of our voices, and of resuscitating the same from mechanical records long after the speaker has passed away. In the arts it plays already an important part through the creation by Jacobi of the galvano-plastic process, and in further extension of the same principle it is rapidly becoming an important agent in the carrying out of metallurgical processes upon a large scale. It has now appeared as the formidable rival of gas and oil for the production of light, and, unlike those inferior agents, it asserts its higher nature in rivalling solar light for the production of photographic images; and finally it enters the ranks as a rival of the steam-engine for the transmission and utilisation of mechanical power.

Who could doubt under these circumstances that there remains an ample field for the exercise of the ingenuity and enterprise of the members of that society I have just had the honour of addressing?

At the termination of the address, it was moved by Col. Crossman, and seconded by Mr. E. Graves, that the same be printed and presented to the members of the society.

A vote of thanks to the past-President, Professor Abel, was then moved by Mr. Latimer Clark and seconded by Major Webber, R.E.

A portrait of the past-President, being presented to the society by Lt.-Col. Bolton, a vote of thanks, put from the Chair, was passed for the same, and then on the motion of Mr. C. V. Walker, F.R.S., a vote of thanks to the Council of the Institute of Civil Engineers for their liberality in allowing the use of the Hall of the Institution for the Society's meetings, was carried unanimously.

On the motion of Mr. Bruce Warren, seconded by Mr. Donovan, a cordial vote of thanks was passed to Mr. W. Langdon, who resigns the office of Acting Secretary to the society.

An exhibition of the electric light from a magneto-electric machine of Messrs. Siemens, and of a new form of voltaic battery, the invention of Dr. Burns of Brooklyn, U.S., terminated the meeting.

THE INSTITUTION OF CIVIL ENGINEERS.

THE first meeting after the Christmas recess was held on Tuesday, the 15th of January, when the newly-elected President, Mr. JOHN FREDERIC BATEMAN, F.R.SS.L.&E., delivered an inaugural address.

After a passing allusion to the growth of the Institution, which at the end of 1844 numbered only 552 of all classes, now increased to 3,189. reference was made to some of the addresses of the eighteen gentlemen who had previously occupied the presidential chair, mainly for the purposes of comparison. Thus, Mr. Robert Stephenson, in summarising the statistics of British railways to the end of 1854, mentioned that 368 millions sterling had been authorised to be expended, of which 286 millions had been raised; whereas at the end of 1876 these figures were respectively 742 and 682 millions. Again, Mr. Locke, in treating of French railways, remarked that at the close of 1856 concessions had been granted for 7,030 miles, of which 4,060 miles were open; whilst at the close of 1876 these mileages were 16,452 and 12,715. Mr. McClean had contrasted the income available for taxation in 1815 with 1856, and had shown that in the interval the revenue from land had not increased, while that from houses had augmented 300 per

cent., and from quarries, mines, ironworks, canals, railways, etc., 1,200 per cent. There was evidence that since 1856 the increase had been very great, even if these high rates had not actually been maintained.

Proceeding to matters more personal to every member of the Institution, the President urged that engineering was but, in fact, the embodiment of practical wisdom; or, in the words of Bacon, "the conjunction of contemplation and action." Thought combined with practice had led to the perfecting of the steam engine by James Watt, to the successful application of the locomotive engine by George Stephenson, and to the production of the electric telegraph. It was to the combination of sound theory with successful practice, that engineering owed its present position, and had been able to advance material prosperity.

The President then gave a brief description of a few of the principal engineering works recently completed, or at present under construction; mentioning in telegraph engineering the telephones of Mr. A. G. Bell and Mr. Edison, and the quadruplex system of telegraphy, imported from America. During the past year electricity had put forward other claims than those relating to means of communication. Thus, the electric light, if it could not at present compete successfully with the convenience in domestic arrangements of gas lighting, had been found useful and effective for the illumination of large spaces, and the invention was about to be applied at the Lizard Point Lighthouses.

In the conviction that experience of a special kind, gained during a long professional life, was of more real value than allusions, however lucid, to a variety of subjects, the President next adverted to a question which was of the highest importance in that branch of the profession to which his attention had been more particularly directed, viz.,—the rainfall of this country, and the quantity of water which flowed off the ground, available for the use of man if properly utilised, or destructive when uncontrolled and permitted to cause floods or torrents. The variation in the rainfall was very great. For instance, on the east coast of England and Scotland the average did now exceed 20 inches per annum; on the south and west coast it was 35 or 40 inches; in the Penuine chain of hills forming the backbone of England, the quantity ranged from 40 to 60 inches; in the highest parts of Wales, Cumberland and Westmoreland a fall of from 60 to 80 inches was reached, while in some parts of the lake districts, it amounted to upwards of 150 inches. The observations of Mr. J. F. (afterwards Dr.) Miller, of Whitehaven, showed that the maximum density of the rain cloud was at about 2,000 feet above the sea level, although local circumstances exercised an important influence upon the quantity of rain which really reached the earth; that the greatest deposition of rain might be expected on that side of a mountain exceeding 2,000 feet in height, upon which the rain cloud impinged, but on the opposite side when the mountains did not rise so high; and that in a succession of ridges and valleys, without intervening mountains of a sufficient height to arrest the progress of the rain cloud, the greatest fall of rain would be in the first trough. In illustration, numerous observations on the rainfall in Lancashire and Yorkshire were given; and it was mentioned that the same results were observed in the lake districts of Dumbarton, Stirling, and Perthshire. As the quantity of rain varied in every disdistrict and depended not only upon elevation but upon the physical and geographical features of the country, nothing could be more fallacious than to attempt to determine, by any fixed ratio, the amount of rain which would probably fall in any district, unless there were some corresponding one, similar in elevation, in proximity to the sea, in exposure to wind, and in other external circumstances with which to compare it. The proportion of this very varying rainfall, which would flow off the surface, depended largely upon the geological character of the rocks, their elevation and declivity, and the manner in which they were clothed with vegetation. The water passed off partly in floods and partly in perennial springs; that issuing from springs varying according to the physical features or lithological character of the district. Absorbent rocks yielded the greatest abundance; next, loosely stratified rocks, and least of all the closely bedded slate rocks and the primitive formations. Generally in the coal measures, the millstone grit, and the primitive formations, the quantity of spring water in the driest seasons would vary from about $\frac{1}{4}$ to $\frac{3}{4}$ of a cubic foot per second per 1,000 acres; $\frac{1}{2}$ a foot per second per 1,000 acres being an average quantity in a dry season. This quantity formed, however, but a small portion of that flowing off the ground in times of flood, which exceeded five or six hundred to one thousand times the quantity of water in dry seasons. The amount of flood waters was an important consideration in all engineering operations, as upon it depended the supply of large storage reservoirs, for canals, for water power, and for the use of towns,—the openings of bridges spanning rivers, the construction of river courses, the drainage of lands, and the effect in "scour" upon the beds of rivers and upon the mouths of harbours.

At the meeting on Tuesday, Jan. 22nd, Mr. BATEMAN, President, in the chair, the paper read was on "Some Recent Improvements in Dynamo-electric Apparatus," by Dr. HIGGS, Assoc. Inst. C.E., and Mr. BRITTLE, Assoc. Inst. C.E.

The authors commenced with a brief review of the rise and progress of this branch of electricity.

A description was then given of the latest construction of Siemens' Dynamo-Electric Machine and Electric Lamp, the latter devised specially for lighthouse illumination, and similar lamps were about to be supplied for the Lizard Lighthouses. The dimensions, weights, number of revolutions made by the cylinder, light equivalent in normal candles, and H. P. required for driving were, for three sizes of machines—

Dimensions in Inches.			Weight in lbs.	Revolutions of Cylinder.	Candles Light.	H.P.
Length.	Width.	Height.				
25	21	8·8	298	1,1000	1,000	1½ to 2
29	26	9·5	419	850	4,000	3 to 3½
44	28·3	12·6	1,279	480	14,800	9 to 10

In the application to lighting purposes the improvements in the present dynamo machines were very great. Thus, with a cost 10 times, with a weight 14 times, and a volume 25 times that of the latest construction, the old form of the machine produced one-fifth of the light, with an expenditure of practically the same driving power.

The results of experiments with the Electric Light Apparatus by Capt. ABNEY, R.E., at Fort Monkton, in July, 1875, were given.

An important factor in the light efficiency of a given machine was the resistance of the circuit leading to the lamps. Experiment indicated that, to obtain a maximum of light, the resistance of the conducting wires should be proportioned to that of the machine.

Much excitement had been evinced as to the probable competition between gas and electricity, as sources of light power. Although, under certain circumstances, these two agents undoubtedly came into

competition, they had two separate fields. Hitherto gas had been employed for lighting spaces of both large and small dimensions, because a better source of light for large spaces had not been procurable with economy. But for lighting large spaces not subdivided by opaque objects or screens, it was a want of economy to employ gas. Assuming light power proportional to H.P. expended, 100 H.P. would give 150,000 candles' light; distributed from three points, the cost would not be more than £1 2s. 6d. per hour, each light-centre giving an illumination which would enable small print to be read at a distance of a quarter mile from the light. A burner giving the light of 20 candles consumed 6 cubic feet of gas per hour, which might be manufactured at a cost of 2s. per 1,000 cubic feet. This gave 7,500 burners' light only, and 45,000 cubic feet of gas at a cost £4. 5s. per hour, a ratio of 4 to 1 in favour of electric lighting. The economical ratios differed greatly, being dependent chiefly upon the price of gas and of the motor power employed. For large spaces the cost of electric lighting was about one-fourth or even one-fifth that of gas-lighting, when steam had been used as power, and wear and tear were reckoned.

At Messrs. Siemens Brothers' Telegraph Works the economy was as 2 to 1 in favour of electric lighting. If, however, the ratio of light-intensities were adopted as the ratio of efficiency, the advantage would be considerably higher (20 to 1) in favour of electric lighting. It might be laid down as proved by experience, that for lighting large spaces, not too much subdivided, the advantage was greatly in favour of the electric light; but that where numerous light-centres of small intensity were required, or where the space was much subdivided, the advantage was in favour of gas. This advantage would cease when a practical method of subdividing the electric light was obtained.

The limit set by distance to the transmission of power, by means at present adopted, had been comparatively narrow. Hydraulic power had been the most adaptable, with, however, several important disadvantages. Although electricity as a means of transmission was also limited by the distance to be traversed, the limit was in this case much more extensible, and under favourable instances practically disappeared.

The employment of the currents of magneto-electric machines for electrotyping and electroplating had long superseded the voltaic current. It was, however, only on a large scale that the current from a dynamo machine could be used with advantage. For small electro separations, or depositions, magneto-electric machines had been constructed. For the deposition of large quantities of metal, where by changing baths in succession little change was made in the total circuit resistance, the dynamo machine gave much greater economy. With one of these machines, and a proper succession of vats, as much as three tons of copper had been deposited daily.

PHYSICAL SOCIETY,—19TH JANUARY, 1878.

The President, Professor G. C. FOSTER, in the Chair.

THE following candidates were elected members of the Society—J. Angell, Lieut. G. S. Clarke, R.E., T. F. Iselin, M.A., J. W. Russell, M.A.

Mr. W. H. PREECE read a paper "On some physical points connected with the Telephone." This instrument may be employed both as a source of a new kind of current and as the detector of currents which are incapable of influencing the galvanometer. It shows that the form and duration of Faraday's magneto-electric currents are dependent on the rate and duration of motion of the lines of force producing them, and that the currents produced by the alteration of a magnetic field vary in strength with the rate of alteration of that field; and further, that the infinitely small and possibly only molecular movement of the iron plate is sufficient to occasion the requisite motion of the lines of force. He pointed out that the telephone explodes the notion that iron takes time to be magnetised and demagnetised. Mr. R. S. Brough has calculated that the strongest current employed in a telephone is $\frac{1}{1000000000}$ of the C. G. S. unit. Mr. Preece explained that the dimensions of the coil and plate depend on the strength of the magnet; but the former should always consist of fine wire, and be made as flat and thin as possible. The adjustment of the position of the magnet (as near as possible to the plate without touching) is easily effected by sounding a vowel sound *ah* or *o* clearly and loudly; a jar is heard when they are too near together. After briefly enumerating the attempts which have been made to improve the instrument, he mentioned the various purposes to which it can be applied. In addition to being useful in the lecture room, in conjunction with several well-known forms of apparatus, it forms an excellent detector in a Wheatstone Bridge for testing short lengths of wire, and condensers can be adjusted by its means with great accuracy. M. Niaudet has shown, by employing a doubly wound coil, that it can be used to detect currents from doubtful sources of electricity, and it is excellent as a means of testing leaky insulators. Among the facts already proved by the telephone may be mentioned the existence of currents due to induction in wires contiguous to wires carrying currents, even when these are near each other for only a short distance. Mr. Preece finds that if the telephone wire be enclosed in a conducting sheath, which is in connection with the earth, all effects of electric induction are avoided; and further, if the sheath be of iron, magnetic induction also is avoided, and the telephone acts perfectly. A great number of experiments on the use of the instrument on telegraphic lines were then described, from which it appears that conversation can be carried on through 100 miles of submarine cable, or 200 miles of a single wire without difficulty, with the instrument as now constructed. The leakage occurring on pole lines is fatal to its use in wet weather for distances beyond five miles. An interesting series of telephones was exhibited, and by means of one of very large dimensions, Mr. Preece showed that the current produced by pressing the centre of the plate sensibly affects a Thompson galvanometer, and that the motion of the needle ceases in a remarkably instantaneous manner as soon as the pressure is removed, a necessary condition in order that the receiving plate should acurately reproduce the motions af the sending plate.

In the discussion which followed, Mr. R. SABINE suggested that the failure of all attempts at improving the instrument by increasing its dimensions might be due to the *damping* action of the permanent magnet on the plate, the strain on it being proportional to the size of magnet, and rendering it less sensitive to the sonorous waves. Mr. COFFIN pointed out how interesting it would be, if instead of employing a receiving instrument, the currents could be communicated directly to the auditory nerves; and Professor ADAMS explained the relation subsisting between the character of the vibrations of the disc and the character of the electric currents to which they give rise.

Dr. LODGE described a simple form of apparatus for determining the thermal conductivity of rare substances such as crystals, which cannot be obtained in slabs or rods.

THE METEOROLOGICAL SOCIETY.

THE Annual Meeting of this Society was held on Wednesday, the 16th inst., at the Institution of Civil Engineers, 25, Great George Street, Westminster. Mr. H. S. Eaton, M.A., President, in the chair.

The council in their report express their gratification at the increase in the number of Fellows and Stations of the Society; the greater size of the Quarterly Journal and the high value placed on it by foreign scientific societies; the augmentation of the Library, and the addition to the sum hitherto contributed by the Meteorological Council, as well as at other evidence of vigour and progress manifested during the year. The number of Fellows now amounts to 417.

The President then delivered his address:—"During his tenure of office the alliance between the Meteorological council and the Society had been further cemented, the Society supplying the Government with certain statistics, and getting some assistance from the Council in return. This arrangement had been completely successful, and the president considered it calculated to foster the growth of climatic meteorology under the auspices of the Society, and likely to remove any jealousy on the part of the public towards a Governmental Department, so peculiarly constituted as the Meteorological Council. After criticising some of the work undertaken by the last-mentioned body, Mr. Eaton exhibited curves of the results of the hourly observations of the barometer and thermometer for the year 1876, at Valencia, Armagh, Glasgow, Aberdeen, Falmouth, Stonyhurst and Kew, these being the stations established in 1868 for determining the meteorological constants of the British Isles. The curves showing the combined diurnal and semidiurnal variation of atmospheric pressure might be referred to one of two distinct types. In one of them the minimum of pressure was most pronounced in the morning, in the other in the afternoon. The former type was found at the maritime stations of Valencia and Falmouth, the latter at inland stations such as Kew. The diurnal range of the temperature of the air was duly related to the pressure. It was least at the maritime stations, reaching only 4° at Falmouth and attaining a maximum of 9·3° at Kew.

The following gentlemen were elected officers and council for the current year:—

President—Charles Greaves, M. Inst. C.E., F.G.S.; Vice-Presidents—Henry Storks Eaton, M.A., James Park Harrison, M.A., Robert James Mann, M.D., F.R.A.S., Charles Vincent Walker, F.R.S., F.R.A.S.; Treasurer—Henry Perigal, F.R.A.S.; Trustees—Sir Antonio Brady, F.G.S., Stephen William Silver, F.R.G.S.; Secretaries—George James Symons, John W. Tripe, M.D.; Foreign Secretary—Robert H. Scott, M.A., F.R.S.; Council—Honourable Ralph Abercomby, Arthur Brewin, F.R.A.S., Charles Brooke, M.A., F.R.S., F.R.C.S., Edward Ernest Dymond, William Ellis, F.R.A.S., Rogers Field, B.A., M. Inst. C.E., John Knox Laughton, M.A., F.R.A.S., Rev. William Clement Ley, M.A., Richard Strachan, Henry Samuel Tabor, Capt. Henry Toynbee, F.R.A.S., George Mathews Whipple, B.Sc., F.R.A.S.

General Science Columns.

ON THE PREVENTION OF FLOODS.

THE large amount of rainfall in England during the last three years, and the consequent flooding of rivers, has caused considerable attention to be directed to the question of floods, with the view of discovering what means can be adopted to avert or remedy them. The Ouse, the Witham, and the Trent have, amongst others, formed the subject of special investigations; and last session the Thames was favoured by being referred to a special committee of the House of Commons.

It is natural that in the rapid advance of engineering science such a subject as the prevention of floods should be brought prominently forward, but the solution of the problem has not hitherto been effected. Floods still occur in every part of the country, and we have quite recently seen large tracts of meadow land covered with water after two days' rain. In July, 1875, the Ouse rose so rapidly at Huntingdon, that the booths erected on the large common outside the town in anticipation of the races, were hastily deserted by their occupants, and the races abandoned. In the same year, large quantities of hay were swept away, and much other damage done in various places. Last winter, there was an alarm that the Trent bank, in the neighbourhood of Lincoln, was in danger of breaking, and the Witham banks did actually give way, and a large extent of fen land below Lincoln was inundated, driving many people from their houses and doing great injury to the crops. The Thames overflowed its banks in many places during the last two winters, and the occurrence of floods in London itself, need scarcely be recalled to the memory of our readers.

Rivers are the channels formed by nature for the discharge of the rainfall to the sea, but generally they are not sufficiently large to carry off more than an average amount of rain, and floods are the natural result of any continuous heavy rainfall. The frequently expressed opinion that floods are more common than in former times appears to be correct; but this is due, not to any increase in the rainfall, but to the reclamation by means of embankments, of large tracts of land bordering the rivers which used formerly to serve as flood reservoirs; to the growth of weeds and the formation of obstructions by the fall of trees or washing away of the banks, and to the extension of subsoil drainage on the higher lands which brings the water down more rapidly into the rivers. The existence of mills and the canalisation of rivers for navigation purposes are detrimental to the free discharge of flood waters. When rivers are large, like the lower portions of the Thames, they have naturally been adapted to navigation, and in smaller rivers, where the fall is considerable the available water power has been utilised by the erection of mills. Millers are naturally unwilling to let off much water through their sluices in the summer for fear that a drought should follow, and in the winter they frequently keep up the water above in time of flood in order to maintain a sufficient head of water to drive their mill when the water tails up below them. The abandonment of navigation, even on the upper portion of the Thames, was considered unadvisable by the Thames Floods Prevention Committee, and any proposal to obtain the relief that might be afforded by this means, would raise considerable opposition; and

the vested interests in mills are so large that their purchase and removal would not be practicable. The rivers must, therefore, be dealt with in their existing artificial state.

To avert all danger of flooding would necessitate a very large outlay; and, moreover, such a thorough measure is not required, as the winter floods, which are the most frequent and the most extensive, are not generally injurious, except where they reach dwelling houses. Where houses are below flood level, they should be protected by embankments; and it should be entrusted to the local authorities of every town to take care that no buildings shall be erected in future on low lands, unless the sites have been efficiently protected from all chance of floods. It is a scandal that houses should be built, as we have seen them, with the ground floor window-sills below flood level. The speculative builder erects houses on low land obtained at a cheap rate, and then sells them in dry weather to unsuspecting persons unaware of the impending floods. The farmer dreads merely the summer floods, which may ruin his grass, carry off his hay, destroy his growing crops, or render his pasture land unpalatable to cattle.

The size of the channel required for an efficient discharge depends upon the rainfall of the district, the area of the water-shed, the permeability or impermeability of the strata forming the basin, and the amount of fall; each river basin, therefore, requires a separate investigation. It is always possible to devise means for averting floods, but where the fall is small the channel must be large, and where the fall is very slight, as in the fen districts, pumping must be resorted to the lift given being practically so much addition to the fall of the bed. The advantage of pumping is that it can be applied to any extent; but besides the first cost of erecting the pumps, there is an annual expenditure. Much may be done by removing weeds and other obstacles from the river bed, enlarging outfalls, shuttles, and tumbling bays at the rivers and mills, straightening the course of the stream where sharp bends occur, rendering its section more uniform, and removing old bridges with contracted waterways and replacing them by bridges with larger openings.

The whole matter resolves itself into one of cost; what amount might be profitably expended in abating floods, and how the requsite money is to be raised. The amount of profitable expenditure depends upon the extent and value of the flooded lands, and the amount of protection or relief required.

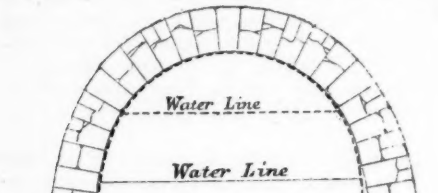
With regard to the raising of the necessary funds, there arises the difficulty that the area of the flooded lands is usually very small in proportion to the whole area of the basin, and the proprietors, moreover, in many instances are unable to bear a heavy rate, especially when their profits have been greatly reduced by a succession of rainy seasons. It appears to us, however, an equitable arrangement that the area of rating should be extended to the entire watershed of a river, and that the more fortunate holders of the higher lands should bear some proportion of the burden of relieving the low lands from floods, as the rain which falls on their land is discharged by the river below, and they have in most instances helped to increase the floods by subsoil drainage. The equalisation of rates in the parishes of London, which shifted a portion of the burdens of the poorer parishes on to the richer ones, and made all pay their proportionate share, is a measure which is manifestly just, and affords a precedent for the arrangement we suggest. To ensure a proper control and supervision of the watercourses of the kingdom, each large river, with its tributaries, should be placed under the jurisdiction of a single board, chosen from persons interested in the district, and armed with ample powers for enforcing at all times the discharge of water to any desired extent at the weirs, sluices, and mills, and the maintenance of a clear and sufficient channel. It is probable that if the course we have indicated were adopted, the periodical complaints about floods would cease, and the rivers become efficient channels for the discharge of floods throughout the summer season.

The French have set us an example by the study they have made of the flow of their rivers; and in the case of the Seine, M. Belgrand, the director of these investigations, by receiving telegraphic information of the rainfall and rise of the upper portions of the river, has been able to predict both the time and height of the floods along the lower parts of the river, and thus give timely warning to the inhabitants of the district, and he considers that this system might be readily applied to many other rivers.

DRAINAGE OF LAKE FUCINO.

LAKE FUCINO was situated in the ultra Abruzzi province, about 53 miles in a straight line, east of Rome, and 96 miles north of Naples. It was the largest lake in Central and Southern Italy, and covered the greater part of one of the largest table lands to be met with in the central part of the Apennines, having an area of about 173,000 acres. This table land is surrounded on all sides by spurs of the main chain of mountains, thus forming a basin quite separated from the adjacent valleys, so that the waters produced on its surface found no outlet by which they could discharge themselves into the neighbouring rivers. The most important as well as the nearest of the valleys situated on the other side of the mountains which gird the Fucino basin, is that of the Liris, which to the west runs parallel for a certain distance with the plateau of the lake, but at a lower level. The river is about 3¼ miles in a straight line from the lake, but between the two there is a mountain, Mount Salviano, and another plain called the *Campi Palentini* higher than that of Lake Fucino. Julius Cæsar was the first to conceive the idea of draining the lake; it was attempted by Claudius, the fourth Emperor in succession from him, and the works which he caused to be executed were considered by Pliny as the most extraordinary of

that age, itself the most brilliant in the history of Roman civilisation. We learn from Suetonius that for eleven consecutive years thirty thousand men were employed at Lake Fucino; Pliny the elder, who saw the works in full activity, says that they cost incalculable sums and where so extraordinary, that no language could give an idea of them. The nature of these works was the excavation of a tunnel through Mount Salviano, at about 984 feet below its summit, and its continuation under the Palentine fields, at an average depth below the surface of 328 feet, with the view of discharging the waters from the lake into the river Liris, at a sufficient height above the latter to enable it, even when in flood, to receive the water from the tunnel. This work was called the emissary of Claudius. Its total length



was 6,114 yards, and it was constructed with a gradient of 1½ in 1000. So far as could be judged from the ruins of the tunnel, its cross section was to have had a surface of 11·9 square yards, but in the execution of the work these proportions were not maintained, and the invert of the tunnel was not kept at the regular slope it should have had. Between its two extreme points, the course of the tunnel was not quite straight, but followed a broken line composed of three sections forming very open angles with each other. In carrying out the work, forty shafts were sunk, of which twenty-nine were situated between the foot of Mount Salviano and the river Liris, and the remainder between the mountain and the lake. The depth of the first group ranged from 232 feet to 400 feet, and that of the second between 57 and 203 feet. In the course of the recent works for reconstructing the Roman tunnel, one of the ancient shafts was opened. The timbering with which it had been lined, though carbonised from its long stay underground, was still in its place, without having shifted in the least. The sides of the square, each measured 14·16 feet, and were supported in the middle by strong cross beams, which thus divided the aperture of the shaft into four equal compartments, each 5·16 feet square. These were made use of for hoisting up the material excavated from the tunnel in skips or buckets, which had a cylindro-conical shape, and were made of copper, strengthened with broad bands of soft iron. Their capacity was only 1·4 cubic feet, and they were suspended by means of hooks, to ropes set in motion by men working at the bars of a vertical capstan, which was mounted on a wooden framework close to the mouth of the shaft. Each shaft had two such capstans, so that two buckets could ascend and two descend simultaneously. This tunnel, after its completion, was opened with great ceremony, and the waters of the lake began to discharge themselves into the Liris, but by an error in the construction of the entrance works, it was impossible that the lake could ever have been thoroughly drained. This defect was corrected, and at a second inaugural *fête*, the regulator was carried away, and although the draining continued for some months, the works were neglected, and allowed to fall into decay. Attempts to re-open the works were made by Trajan and Hadrian, and in the middle ages by Frederic II., perhaps also by Alphonso I. of Aragon, and by several sovereigns of Naples, but always in vain. This long succession of failures had caused the draining of Lake Fucino to be regarded as an impossibility, till Prince Torlonia succeeded at last in overcoming the difficulties, which for eighteen centuries had resisted all the attempts of the most powerful sovereigns.

In 1851, owing to the injury caused by the rising of the lake, a company was formed to whom a concession was granted for the drainage of the lake, on condition that they should carry out all the works at their own risk and cost, and receive in exchange the proprietorship of the lands they should reclaim. The engineers to whom the execution of the works was entrusted were Messrs. Charles Hutton Gregory and William Parkes, who were respectively appointed consulting and resident engineers. After elaborate surveys and examinations on the spot, an exhaustive report, a copy of which is now before us, was submitted in February 1854, recommending the construction of a tunnel of 230 superficial feet opening, of which 165 feet was intended to be the maximum area of the stream running 14 feet deep, leaving above it an area of 65 feet for the passage of air. While the constitution of the company was under discussion, the late M. de Montricher submitted to Prince Torlonia a proposal based on the data obobtained by the English engineers, of which the main feature of difference was that the tunnel was to have an area of 130 feet section, instead of 230 feet, and consequently be much less costly. Prince Torlonia having purchased up the rights of the company, undertook the work at his own sole cost, and appointed M.

de Montricher, the engineer-in-chief. He subsequently submitted to Prince Torlonia an amended project for a tunnel 217 feet area, with the stream to run 17½ feet deep, and 195 feet area, leaving 22 feet free. This project was afterwards carried out, and thus, the great saving of cost, which would have been effected by the reduced area of tunnel in M. de Montricher's first design, was not realised, while the previous conclusion of the English engineers as to the capacity that should be given to the tunnel was fully confirmed. The whole of the details appear to have been newly designed under M. de Montricher's directions, but on principles identical with those on which the details of Mr. Gregory and Mr. Parkes were based. The accompanying sketch shows the cross section of the tunnel proposed by Mr. Gregory and Mr. Parkes, whilst the dotted lines within it show the cross section adopted by M. de Montricher. This is given in order to show how closely the French engineer followed upon the design of the English engineers.

The construction of this tunnel necessitated the destruction of the old Roman tunnel. Upon the section adopted, and with a general slope of 1 in 1,000, it was calculated that a discharge of 11004·834 gallons per second would be obtained. The invert of the Torlonia tunnel, at its outfall on the Liris, is placed 2·65 feet lower than the Roman tunnel at that spot. From this point a slope of 2 in 1,000 is given to the first 393·6 yards of the invert, and 1 in 1,000 to the rest of its course. The works began with the erection of a dam, destined to isolate as much as possible the head of the Roman tunnel and the structures in front of it, from the waters of the lake. This dam was formed by two parallel arms, 240·598 yards distant from each other, and connected by a curve of 120·299 yards radius, its total length being 1640·44 yards. Within this was another dam, the space enclosed between the two being 32 acres. These works were begun on the 10th of July, 1854. In the construction of the tunnel, several of the old Roman shafts were re-opened, whilst in some cases entirely new shafts were sunk. During the course of construction of the works, temporary expedients were adopted for a partial drainage of the lake on two separate occasions. The Torlonia tunnel was completed in November, 1869. It has a total length of 6887·51 yards, of which 2813·3 yards were excavated through compact rock, and left without revetment; 344·3 yards through pudding stone and lined with bricks; and 3729·8 yards through clay, detached rocks, &c., where it is lined with strong masonry of hewn stone. For its construction 28 shafts were sunk or repaired, twelve of which were over 279 feet in depth; and two inclined galleries were constructed, having a total length of 568·3 yards. The head works of the tunnel were constructed subsequently; they are as follows:—Before reaching the entrance of the tunnel, its cross section gradually increases both in height and width along a distance of 21·8 yards, until it reaches an area of 430·56 square feet at its mouth. The head of the tunnel consists of a pile of masonry built of hewn stone 20·34 feet in depth, provided with a cutwater. This pier divides the tunnel into two parts, the cross section of each of which is a little more than one-half of the area of the cross section of the tunnel. The head of each of these is fitted with a safety sluicegate. In front of the tunnel there is a basin, called the regulating basin, the bottom of which is at the same level with the sill of the tunnel. This basin is rectangular, and at the side opposite to the entrance to the tunnel is a dam, which also forms the end of the canal excavated to conduct the waters of the lake to the tunnel.

The direct results of this drainage have been the recovery of about 35,000 acres of land which were formerly submerged; but the indirect results in affording protection to land that was previously submerged, and increasing the salubrity of the locality have been of no slight benefit. The works undertaken comprised, besides the tunnel itself, planting, drainage, construction of roads, &c., &c., and they have cost, including interest on capital outlay, and all other incidental and miscellaneous charges, nearly £1,800,000, the whole of which has been borne by Prince Torlonia.

MANUFACTURE OF RUBIES.—At a recent *séance* of the French Academy of Sciences, MM. Frémy and Feil, gave an account of their processes for the artificial production of corundum and many other crystalline silicates, and illustrated it with some splendid samples of their labours. The artificial production of crystallised alumina, which is the basis of a great many Oriental gems, and especially of the ruby and sapphire, has hitherto engaged a number of experimenters of whom Ebelmen and Senarmont were the chief. These did not, however, succeed in making any other than extremely small crystals. MM. Frémy and Feil, on the other hand, have produced crystals of a size capable of being used in watch-making, and cut by the lapidary. The process consists in keeping for a considerable time, at a red heat, a mixture of aluminate of lead and silica. The experiment with thirty kilogrammes of the mixture has been kept up during more than twenty days in the oven of M. Feil. Under the action of the heat, the alumina disengages itself little by little from the lead, and crystallises out as colourless corundum; but if two or three per cent. of bichromate of potash is introduced into the mixture, the crystals acquire the tint of rubies. In the same way, with a little oxide of cobalt for colouring matter, sapphire is produced. In density, hardness, brightness, and even colour, the agreement between the artificial and natural stones, is said to be most accurate, and M. Jannettaz has found the optical and crystallic properties to be identical. Among other silicates obtained by MM. Fremy and Feil, disthene may be mentioned. It crystallises out in long, colourless spines or needles, similar to those found in nature. The authors stated that they had in

view only the scientific aspects of the subject, and freely made their process public.

A SPECTROSCOPE WITH A FLUORESCENT EYE-PIECE.—Mr. J. L. Soret has published a detailed account of his application of the well-known property of fluorescent substances to the observation of the ultra violet portions of the solar spectrum. He places a screen made of the fluorescent body at the focus of the object glass, so that an image of the spectrum falls upon it, and examines the projected image by means of an eye piece placed obliquely, so that the diaphragms and blackened walls of its tube extinguish the direct rays from the spectrum. The screen is either a plate of uranium glass or a cell filled with an aqueous solution of esculine; and the spectroscope is best fitted with lenses of quartz and prisms of Iceland spar. When the lenses were of glass, and the prisms of flint, the spectrum lines could not be distinguished beyond N; but with quartz lenses and spar prisms, they were visible as far as T. M. Soret has made observations on the Alps at 3180 metres high, and concludes that although the ultra-violet spectrum is more brilliant at high elevations than on plains, it has no greater extent. In these observations he could not distinguish rays more refrangible than T. He infers that it is the atmosphere of the sun, and not that of the earth which absorbs the most refrangible rays of the spectrum. The observed diminution of brilliance in the more refrangible portion of the spectrum on passing from a higher to a lower altitude, he considers to be due, not to selective absorption by the constituent gases of the air, but to the action of floating particles of liquid or solid impurities which, when more than usually abundant, produce an evident haze or collect in clouds. The general absorption of light due to the last cause affects all the rays of the spectrum; but to a greater degree in proportion as the rays are more refrangible.

OXIDISING EFFECT OF SUNLIGHT.—M. Chastiany considers the oxidation of certain inorganic metallic compounds to be a definite effect of the sun's rays, and locates this peculiar oxidising power in a different part of the solar spectrum from the well-known reducing power. His conclusions are chiefly drawn from the observation that oxidation of such substances as ferrous sulphate, alkaline solution of arsenious acid, and aqueous solutions of hydric sulphide, or alkaline sulphides, proceeds more rapidly in the light than in the dark; and he endeavours to estimate the action of the light by the difference in the rapidity of the process in the two cases, all other conditions being the same. He is of opinion that the chemical action of the rays of the solar spectrum on metallic compounds, both salts and binaries, is a reducing action at the more refrangible or blue end, and an oxidising action at the less refrangible or red end. The general reducing action of white light is perhaps due to the fact that in the rays as a whole, the reducing action is the most powerful of the two. The green rays, he takes to have a reducing influence, but locates between the rays D and E, a neutral point in the spectrum, at which chemical action takes place as it does in darkness. On organic bodies, however, it appears that the action of light is always of an oxidising tendency, and this effect increases on passing from the red to the violet end of the spectrum, with a probable variation from the law in the green rays.

CHEMICAL ACTION OF LIGHT.—Professor H. W. Vogel, in opposition to M. Chastiany's theory, that the chemical action of the various rays of the spectrum on inorganic substances depends on their refrangibility, maintains that the nature of the substance causes the action to be of a reducing or an oxidising nature. Professor Vogel regards the rapid union of Hydrogen and Chlorine in violet light as analogous to oxidation, and he refers to the recent experiments of Zimiriazeff, shewing that the reduction of carbonic acid by plants proceeds more rapidly in red than in green light.

UTILISATION OF SLAG.—The ordinary waste slag from iron smelting furnaces has been of late very ingeniously utilised by a young English engineer, named Dickinson. Mr. Dickinson transforms it into sand, and also into mineral wool. The process in both cases is simple, but surprising. To turn into sand the molten slag is run into a rotating water wheel, which has the effect of granulating it so that in a few minutes the red hot fluid slag can be carted away in the form of sand. To turn it into wool, the molten slag is made to flow out of a pipe, and a jet of steam is played across the surface of the outflow. This has the curious effect of tearing off the slag in the form of very fine glassy fibres, white and lustrous as wool. The steam carries the fibres with it against a screen of netting, from which they are gathered. Being an excellent non-conductor, this mineral wool is used for packing in engines.

USES OF WATER GLASS.—The uses of silicate of soda are more and more extending, notwithstanding that the business of its manufacture is still in its infancy. The greatest demand is for soap making. It is better than the addition of resin, and its alkalinity adds to the cleansing power. It retains water, keeps the soap from shrinking, and prevents great loss of weight. It can scarcely be called an adulteration. It is used as paint, and mixes with all mineral colours; there are even now factories which make paints of mixtures of oil paints and water-glass. It makes the paint more durable, and gives it a gloss-like varnish. It is also indispensable as a mordant for calico-print works, and at present, therefore, extensively used as such. It makes an excellent fireproof cement for stone and iron foundries, especially in putting up iron fronts for buildings. It is the main ingredient in several methods of making artificial stone. For instance, in the Ransome

process, which, in England, consumes thousands of tons yearly. It makes an excellent adhesive mucillage, and is used in a cheap mixture to mend china, glass, and wood. Being perfectly fire-proof, it will give its quality to wood or paper when this has been soaked in it; and being, when dry, also water and damp proof, it is the best coating for brick vaults, and thus very valuable for beer brewers, sugar refiners, &c. These are not all the praiseworthy qualities of this valuable material.—*The Polytechnic Review.*

IRIDESCENT GLASS.—A process for making this glass iridescent has been patented by M. Clenandot. Beautiful effects are produced. The main feature of the process is the application of acids to the glass, under a pressure of from two to five or more atmospheres. Water containing 15 per cent. of hydrochloric acid, is used to bring out rainbow tints like mother of pearl, and artificial gems of various sorts have thus been manufactured. The glass prepared by these processes is quite as iridescent as is that which antiquarians so much value; the pressure and the acids hastening a result that the ordinary agencies of the atmosphere would take centuries to produce.—*New York Tribune.*

CRYSTALLISED GLASS.—M. Vizeau, Director of the Blanzy Glass Works, has obtained some beautiful crystals of glass from a crucible that had been in use during eight and a half months in a Siemens' furnace.

NITRATE OF LEAD AS A DEODORISER.—A writer in the *Lancet* recommends nitrate of lead as a quick and effective deodoriser. Half a dram of nitrate dissolved in a pint of boiling water, when mixed with a pail of water in which two drams of common salt have been dissolved, forms, when the sediment settles, a deodorising fluid of great power. A cloth dipped in it and hung up in a fœtid apartment will, it is stated, soon sweeten the atmosphere.

FORM OF MOLECULES.—Professor J. Clerk Maxwell deduces from the conclusions of a paper by Herr Boltzmann "On the Nature of Gas Molecules," that the molecules of chlorine, ammonia, and sulphuretted hydrogen are rigid elastic bodies; those of hydrogen, oxygen, nitrogen, air, carbonic oxide, nitrous oxide, and hydrochloric acid, smooth figures of revolution and those of mercury, gas smooth spheres.

DISCOVERY OF SPRINGS.—M. Baour points out that permanent supplies of underground water may often be discovered by observing the area over which the air quivers on a clear summer day, when the sun is near the horizon and the air is still. Some of the success formerly attributed to the "divining rod" may have been due to an acquaintance with this mode of search.

INFLUENCE OF TREES ON MOISTURE.—M. Fautrat, from observations made in France, finds that more rain falls on forest than on open land, and on pines rather than on leafy trees. Pines retain more than half of the water that is precipitated upon them, while leafy trees allow 58 per cent. to reach the ground. Pines are therefore the best safeguard against sudden inundations and the best means of giving freshness and humidity to an arid climate like that of North Africa.

INCOMBUSTIBLE SILICATE BOARD for roofing is being manufactured in Belgium. It is prepared by saturating alternate layers of pasteboard with silicate of soda and with a solution of chlorate of barium or other salts, which produce insoluble silicates, such as salts of zinc, calcium, magnesium, and aluminum. The mass of the board hence becomes saturated with insoluble silicate of barium and silicic acid, which render the material at once fire and weather proof. The preparation can be applied to paper, wood, and textile fabrics, and to finished articles as well as to raw materials. The board is light, durable, and tough. It is also capable of being decorated with colours, and is said to cost little.

Tiles of Asphalt for flooring purposes have also been recently employed in Bavaria.

AN ARTESIAN WELL for the purpose of supplying the public baths and municipal establishments of the city is now being bored at Pesth, in Hungary. It has already been sunk to a depth of 951 metres, and is the deepest well in the world. The outflowing water has a temperature of 161° Fah., but it is intended to continue the boring until the temperature of the water is 178° Fah. The jet shoots up 35 feet above the orifice, and 175,000 gallons of warm water are delivered daily. This quantity is more than sufficient for the needs of the city, and some of it will probably be utilised in converting the space surrounding the well into an artificially-heated garden. A motor capable of being driven by the water-jet has also been invented.

City Notes.

Old Broad Street, Jan. 31st, 1878.

IT is gratifying to us to find that the policy we have throughout pursued in the conduct of this department of the *Telegraphic Journal* is being emulated the other side of the Atlantic, where, as in England, the ignoble army of monopolists have done their best to make things pleasant for themselves. Not only does the *Operator*, a lively and well-conducted journal, devote a leading article in which, while announcing the formation of a powerful telegraph company, it warns the monopolists that their day of triumph may be over; but the *New York Tribune* administers a sharp rebuke to the wire pullers, and finally tells them that "the rule that a monopoly cannot long exist in a free republic is a safe one to rely upon." It is true that the opponents of monopoly are even now compelled to

admit that the new company may go the way of its predecessors, and fall into the hands of the Egyptians. We shall watch the issue of the conflict with great interest; but whatever delay there may be in the defeat of the monopolists, the end is not dubious. As our contemporaries intimate, the American public will not continue to pay high rates when low ones are possible. We can assure our friends who are fighting against monopoly in America that what is true of a free republic is true also of a country governed by a limited monarchy. Monopoly, for any length of time, is quite as impossible here as it is in the United States. Mr. Pender and his associates did, undoubtedly, lay their plans with extraordinary skill, and it would be as foolish to deny that they have obtained an apparent victory, as it would be to maintain that they have sacrificed their own interests to those of the general public, or of the shareholders whom they have led captive at their will. But they, like the monopolists in the United States, have digged a pit for their own feet.

We have no authority for stating that the French cable scheme, more popularly known as the "Pouyer Quertier" scheme, will come before the public immediately; but it is engaging a great deal of attention just now both in this country and in France. The fact that half the capital is subscribed justifies this, and it is no secret that the company is being backed by very powerful influence. It may soon prove something more than a phantom to the monopolists who still affect to ridicule the idea of opposition.

So, too, may the bill we recently alluded to at some length as being before the American House of Representatives, though we confess that the latter scheme is rather extensive. If we are rightly informed, the promoters propose to connect the United States by way of the Azores, with Portugal, France, and England, continuing the cable along the Mediterranean and also across the North Sea to Russia. It is urged that by the construction of this cable, America would, in the event of war with England, be rendered independent of the English companies. But that plea seems hardly worth consideration; the chances of war between this country and America are extremely remote—so remote indeed that it would be idle to discuss them. Americans are, we know, very fond of going in for big things, but it is folly to attempt to do too much, and the scheme would be more likely to find general favour if it were limited to connecting France and England only with the States.

The dividend declared by the Eastern Telegraph Company is at the rate of 5 per cent. per annum on the ordinary shares. We have not been favoured with a copy of the report, but we gather that the chairman of the company is well satisfied with the half-year's operations—that is one blessed result. Mr. Pender announced at the meeting that the duplication of the cables had been a financial success, and he quoted figures to prove that the income of the company had considerably increased during the six months. It does not appear to have occurred to any one to raise the point, but we observe that an item of £14,000 of the amount expended in repairs to the cables was charged to the reserve fund instead of to revenue. This ought not to be. All repairs to cables are properly chargeable to, and should be paid out of, revenue. If the principle of absorbing a reserve fund to meet the expenses of cable repairs were generally recognised, it would be a serious matter. What constitutes a current expense in the case of the Eastern Company if cable repairs be not one? Mr. Pender concluded his speech at the Eastern meeting by stating that the directors of the company "were always open to encourage scientific men and inventions." The remark must have provoked many a smile from telegraph engineers, whose interests, as we showed in our last, Mr. Pender has done so much to promote.

The Directors of the Direct United States Cable Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ending, Dec. 31, 1877. The dividend will be payable on and after the 11th of February.

We shall, no doubt, have something to say about the report of the Anglo-American Company, and the proceedings at the half-yearly meeting; but the bald resolutions which were passed at a recent meeting of the Board do not call for comment. The dividend upon the ordinary consolidated stock for the last half-year the directors recommend at 1½ per cent, a balance dividend of 1 per cent. upon the preferred stock for the half-year, and a first and final dividend of 2 per cent. on the deferred stock for the year, making in all, with the dividends already paid, 4 per cent. on the ordinary stock for 1877.

We learn from the report submitted to the shareholders at the annual meeting on the 10th inst. at Montreal, that the Montreal Telegraph Company has not suffered so much as the directors expected from what they not inappropriately call "the disastrous times." The net profit for the year 1877 is 168,671 dols. 43 cts., and the number of messages sent over the lines of the company in 1877 showed an increase of 3,642. While the revenue has increased the expenditure has decreased. The balance-sheet of the company appears, on the whole, to be satisfactory.

It is satisfactory that, in spite of the universal depression of trade, there has been little decline in the value of railway property during the past year; and on the passenger lines there has, in some cases, been an improvement. Thus the Brighton dividend, which was 7¼ per cent. at this time last year, is 8¼ this, and the Metropolitan has risen to 5 per cent. Some of the other Companies, whose dividends have not, at the time we write, been declared, will, doubtless, be able to point to an equally pleasant result of the half-year's operations. No importance should be attached to the increase in the Great Eastern dividend, which had better have remained at 1½ per cent., and the South Eastern has not made progress.

We notice that a vigorous attempt is being made to frustrate the hopes of the promoters of the fusion of the South Eastern and Chatham and Dover Companies. It appears to us that the shareholders have a powerful reason for desiring the success of the Bill before Parliament, especially those of the Chatham Company. But if it can be shewn that the union of the Companies will be injurious to the interests of the public, the opposition will command and deserve encouragement. The fate of the Bill will be known before the close of February.

Sir Edward Watkin made a lame attempt the other day, at the half-yearly meeting of the proprietors of the Manchester and Sheffield Company, to defend his Board from the censure which had been visited upon them for allowing the negociations with the Great Northern and Midland Companies to fall through. According to Sir Edward, it was because the Midland Railway was included in the scheme that it came to nothing; an alliance with the Great Northern alone would have been advantageous. Perhaps it would—to the Sheffield Company. But the proprietors, though they did not say anything, must have felt that their Chairman was talking nonsense when he repeated the contention that the Sheffield Company was entitled to "an absolute 4 per cent guarantee." Possibly, Sir Edward; but people often think they are entitled to things and don't get them—because other people do not see through the same spectacles.